Sixteenth Annual Meeting — American College of Chest Physicians
St. Francis Hotel, San Francisco, California, June 22-25, 1950

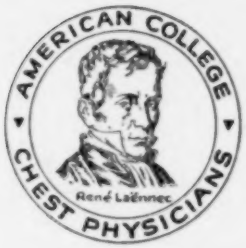
VOLUME XVII NUMBER 3

DISEASES

of the

CHEST

OFFICIAL PUBLICATION



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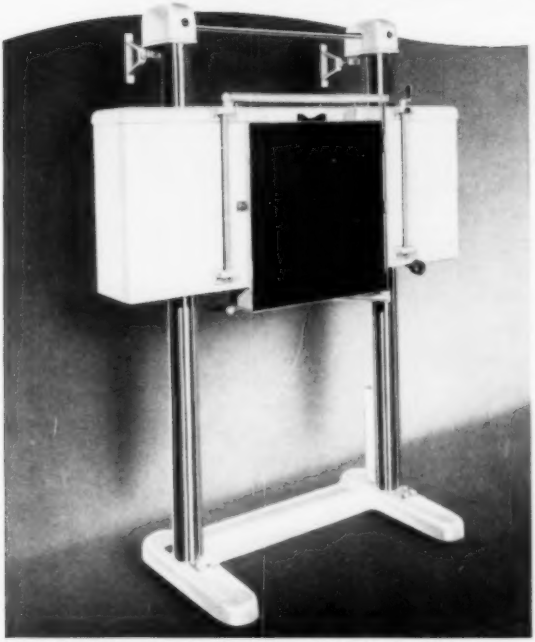

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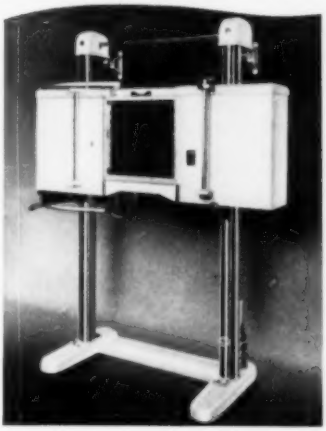

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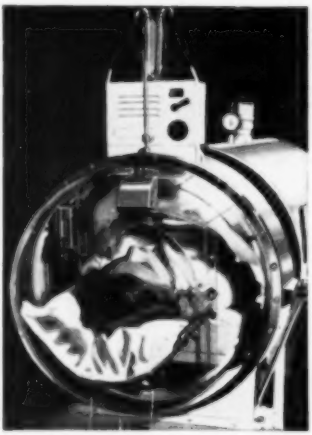

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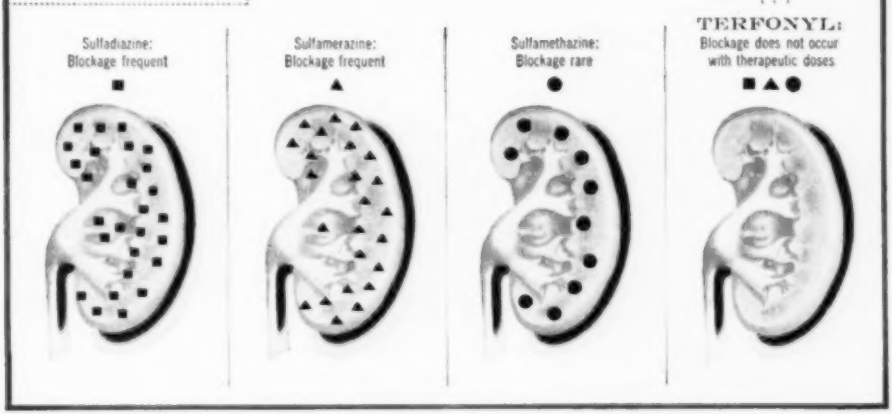

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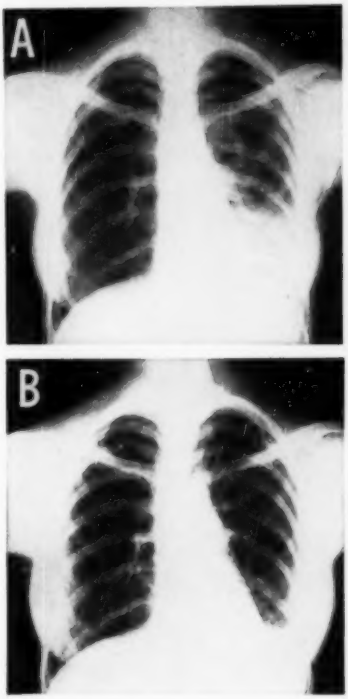

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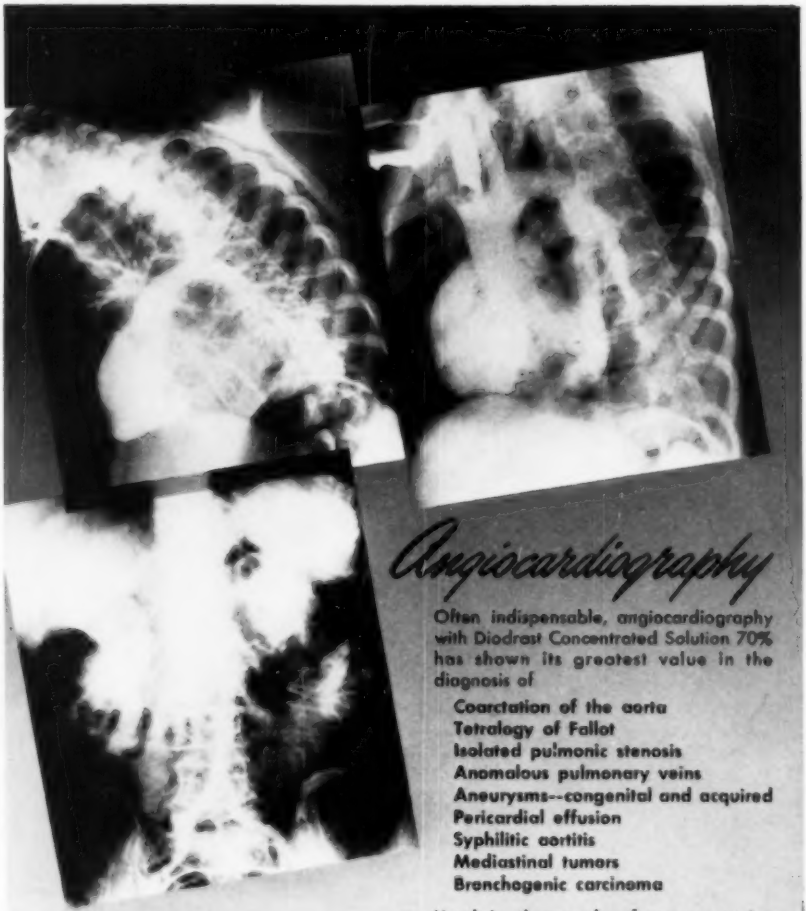

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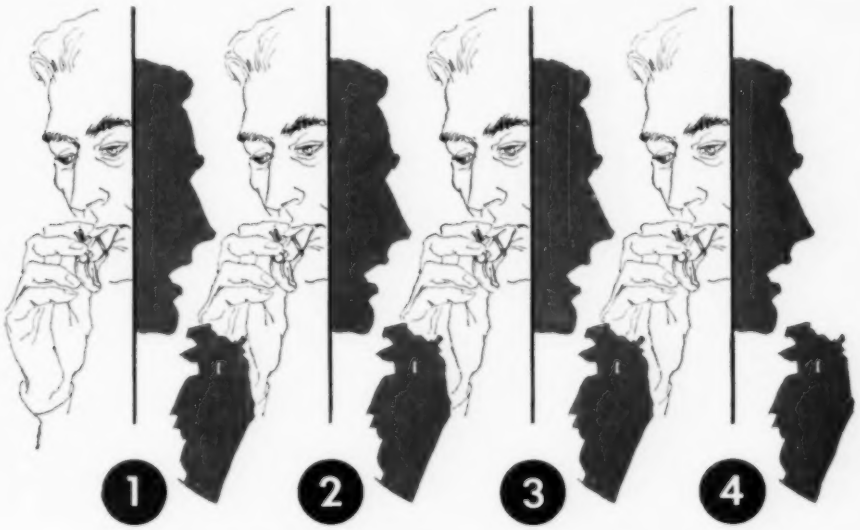

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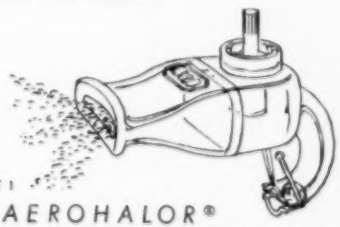

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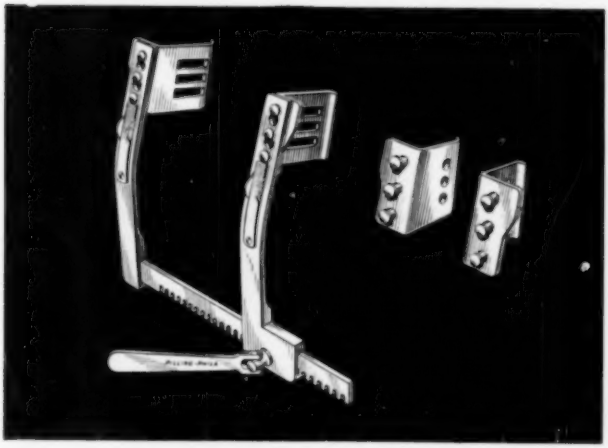

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DISEASES *of the* CHEST

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Studies in the Clinical Evaluation of Disability in Anthracosilicosis*

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Anthracosilicosis has long been recognized as a disabling pulmonary condition. The pathology and clinical features are well established, but present criteria for the evaluation of disability as based on ordinary examination are inadequate. In many instances the decisions are largely speculative, especially when dyspnea and weakness are associated. Even with advanced architectural changes there may be minimal disability, and conversely, marked disability may be present with minimal changes. Recent advances in respiratory physiology have demonstrated the complex nature of pulmonary function impairment and the physiological tests now available provide additional information for a more accurate evaluation of pulmonary disability. Pulmonary function studies would be desirable on all cases where the degree of disability present is a problem, but until such time as these tests are more generally available, disability will continue to be evaluated on primarily clinical and roentgenological findings.

During the past year and a half an unselected group of 375 hard coal miners with various stages of silicosis have been admitted to the Barton Memorial Division of Jefferson Hospital for detailed study of their respiratory impairment. At the same time evaluation of the nature and degree of disability was made by one of us (P.A.T) on the basis of history and physical examination. In

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over 150 of the above cases the efficiency and limitations of the clinical observations were correlated with the pulmonary function studies.

Method of Study

Proper evaluation of disability requires the recognition and consideration of all contributing factors. Table 1 shows the studies which were used.

1. *History—Occupational and Medical:*

Information was obtained on the nature and duration of occupational exposure to coal dusts. It was recognized that the degree of exposure varied with the type of work and the mine worked in, but for practical purposes it was considered that all underground miners received sufficient dust exposure to class them as a group in distinction to those who worked above ground or outside where dust exposure was less. The period of incapacity was then recorded.

Information on past illnesses such as disabling colds, pleurisy, pneumonia, tuberculosis and heart disease was recorded in order to afford a basis for judging the cause, nature and extent of existing pulmonary changes and to evaluate their role in causing disability. Only colds severe enough to cause loss of two or more days from work were classed as disabling.

TABLE 1

Studies Necessary for Clinical Evaluation of Disability

I. History
A. Occupational
B. Medical
II. Physical Examination
III. Exercise Test
IV. Laboratory Studies
A. Sputum
B. Complete Blood Count
C. Urinalysis
D. Blood Serology
E. Urea Nitrogen
F. Fasting Blood Sugar
G. Fishberg Test
H. Blood Serum Proteins with A G ratio
I. Sedimentation Rate
J. Tuberculin Test
V. Electrocardiography
VI. Fluoroscopy and Roentgenogram of Chest
VII. Bronchoscopy and Bronchography
VIII. Pulmonary Function Studies

The actual causes for work stoppage were noted with special reference to the onset of the chief complaint and the subsequent complaints. The occurrences of cough, expectoration, dyspnea, hemoptysis, chest pain, weakness, weight loss, fever, night sweats and edema of the feet were particularly recorded. An attempt was made to differentiate the acute symptoms from the chronic or long standing manifestations, as for example, the onset of sudden cough and expectoration in contradistinction to mild attacks of cough and expectoration of 10 or more years duration.

2. *Physical Examination:*

Physical examination was general with special attention to the chest. The presence of obvious dyspnea at rest, orthopnea, pallor, cyanosis, clubbing of the fingers, curvature of the finger nails and state of nutrition were noted as well as the appearance and movements of the chest with measurement of the degree of expansion. Changes in the percussion note and alterations of the breath sounds were recorded. Particular stress was placed on the presence and character of rales. These were classified as dry (musical) or moist in type and generalized or localized in distribution. The heart was studied for evidence of enlargement, irregularity and murmurs.

3. *Exercise Test:*

The exercise test consisted of 30 step-ups on a nine inch stool. The pulse, blood pressure and respiratory rate were recorded before and two minutes after the exercise with the patient laying flat in bed. The test was omitted when the patient was obviously too disabled to exercise and when contraindicated by medical conditions.

4. *Laboratory Studies:*

The amount of sputum expectorated in 24 hours was measured in grams. If the admission plain smear revealed no acid-fast bacilli, then three other consecutive daily specimens were examined. If these were negative, a 24 hour concentrate, a 72 hour concentrate, and three examinations of the fasting gastric contents were made consecutively. At the same time one of the plain smears was cultured for tubercle bacilli.

Other examinations included a urinalysis, complete blood count, Fishberg concentration test, blood sedimentation test, fasting blood sugar, urea nitrogen, Wassermann and Kahn, and determination of the serum protein, albumin and globulin. Tuberculin testing using first and second strength PPD was carried out in all cases except in miners with manifest tuberculosis.

5. *Electrocardiography:*

This was only employed when cardiac involvement was suspected or where complete studies were carried out. The standard limb lead and three chest leads were used.

6. *Roentgenography:*

X-rays of the chest of all miners were taken at the end of full inspiration and after deep expiration in posterior-anterior view. Fluoroscopic examination was carried out routinely to determine the true motion of the diaphragm, to note abnormalities in the size and contour of the heart, and to localize significant changes in the lungs. A barium mixture was given and notation made as to displacement and encroachment of the esophagus. X-rays of other parts of the body were done as indicated.

7. *Bronchoscopy and Bronchography:*

Each miner with suspected tuberculosis, but with sputum negative for acid-fast bacilli received a bronchoscopic examination, the secretions being studied bacteriologically. In possible neoplasm the secretions obtained by bronchoscopy were studied with special reference to the cytology. All cases with mixed or non-specific infections were also examined bronchoscopically and in most instances an autogenous vaccine was prepared .When bronchiectasis

TABLE 2

Pulmonary Function Studies

	Predicted	Observed
1. Maximum Breathing Capacity (MBC)	L/min.	
2. Residual Air	cc.	
3. Vital Capacity (VC)	cc.	
4. Total Capacity	cc.	
5. Residual Air Per cent Total Capacity	25% or less	
6. Ventilation, Resting, Basal	5-6-L/min.	
7. Breathing Reserve as Per cent MBC	95%	
8. Oxygen Removal cc./L Vent. Exercise	55 cc.	
9. Oxygen Removal cc./L Vent. Rest	45 cc.	
10. Effective Tidal Air	70%	
11. Arterial Oxygen Saturation, Exercise	96% +	
12. Arterial Oxygen Saturation, Rest	96% +	
13. Arterial pCO_2—Rest	40 mm. Hg.	
14. Arterial pO_2—Rest	95 mm. Hg.	
15. Alveolar pO_2—Rest	100 mm. Hg.	
16. Aeration Gradient, pO_2 from tracheal inspired air to alveolus—Rest	50 mm. Hg.	
17. Transfer Gradient, pO_2 from alveolus to arterial blood—Rest	5 mm. Hg.	
18. Duration of Dyspnea after mild exercise	1 min.	

or atelectasis was suspected bronchography with iodized oil was employed.

8. *Pulmonary Function Studies:*

Some or all of the pulmonary function determinations shown in Table 2 were carried out in selected cases. The degree of pulmonary emphysema was evaluated from quantitative measurements of residual air as determined by the oxygen open circuit method.[1,2] The residual air was expressed as per cent of the total lung volume (residual air plus vital capacity). Maximum breathing capacity, vital capacity and supplemental or reserve air were determined with a modified Benedict-Roth Metabolism Apparatus.[2,3] Studies of the respiratory gas exchange, obtained from analysis of the expired air and arterial blood drawn directly from the brachial artery, provided information pertaining to the oxygen transfer in the lungs and the pulmonary blood flow.[4,5]

Medical Findings

Data obtained from the history are summarized in Tables 3, 4, and 5. All ages were studied, the youngest being 29 and the oldest 79. The majority of miners (42 per cent) varied in age from 51 to 60 years, with 55 years as the average age for the whole group. Underground exposure differed widely in all age groups and varied from three to 64 years, the average being 32 years. It was noted that 47 miners (17 per cent) were still working at time of study, usually outside of the mines, the rest having stopped work up to 17 years prior, with an average period of work stoppage of 2.4 years.

TABLE 3

Findings from History of 375 Hard Coal Miners

	Years	Average
Age Range	29 to 79	55
Exposure Range (Inside)	3 to 64	32
Disability Range	0 to 17	2.4
Past History	**Number**	**Per cent**
Disabling Colds	139	37.1
Bronchitis	14	3.7
Pleurisy	52	13.8
Pneumonia	82	21.8
Tuberculosis	20	5.3
Heart Disease	54	14.6

It was noted that the work history followed a definite pattern. Generally the miner would start work at a very early age as a helper or laborer. After a few years he would become a contract miner or a company miner and actually drill for coal, with a jack-hammer or cutting machine. After a varying number of years, when there was a decrease of productive capacity, lighter work underground would be assigned or the miner laid off, or given a job above ground.

A history of previous respiratory infection, either disabling colds, bronchitis, pleurisy or pneumonia (Table 3) was found in 287 cases (76.4 per cent). Pulmonary tuberculosis, either proved or suspected, was recorded in 20 cases (5.3 per cent) and 54 (14.6 per cent) stated that they had had a previous diagnosis of cardiac disease.

The chief causes for work stoppage are shown in Table 4. In

TABLE 4
Chief Cause for Work Stoppage

Cause	Number	Per cent
Dyspnea	269	72.2
Chest Cold	27	5.5
Weakness	15	3.5
Chest Pain	12	3.2
Hemoptysis	8	2.3
Onset of Tuberculosis	4	1.8
Heart Disease	3	1.6
Non-Medical	37	9.9
TOTAL	375	100.0

TABLE 5
Present Symptoms of 375 Cases

Cause	Number	Per cent
Dyspnea	340	92.3
Cough	328	87.5
Expectoration	315	83.5
Weakness	260	70.6
Weight Loss	255	69.5
Chest Pain	159	44.3
Hemoptysis	141	35.8
Night Sweats	61	9.6

approximately three fourths of the cases (72.2 per cent) the miner was forced to stop work and to leave the mines because of varying degrees of dyspnea. Usually the miner would notice shortness of breath on exertion, particularly on walking, several years prior to work stoppage. This would gradually increase in severity and eventually easier employment was requested or work stoppage occurred altogether. In 26 cases the onset of dyspnea was abrupt but the remaining number showed a gradual onset varying up to 18 years, the majority (45.5 per cent) occurring within two years. Non-tuberculous respiratory infections varying from acute colds to pneumonia were next in frequency, but caused permanent work stoppage in only 5.5 per cent of cases. Hemoptysis, though present in 35.8 per cent of cases, was given as the main cause of work stoppage in only 2.3 per cent. Non-medical causes included miners where work stoppage occurred because of injuries, age factors, or closure of the mines, and accounts for 9.9 per cent.

The symptoms at the time of the study are shown in Table 5. Dyspnea was mentioned in the majority of cases (92.3 per cent). No attempt was made to classify the severity of dyspnea inasmuch as it depended upon the nature of the pulmonary involvement and the presence of associated diseases. It appeared early in the course of the disease and was more gradual in onset in those cases where the involvement was of the typical nodular type. In cases with massive conglomerate lesions dyspnea was frequently more sudden in onset and of shorter duration before disability resulted. Varying degrees of cough (87.5 per cent) and expectoration (83.5 per cent) were constant findings and showed a periodicity in relation to associated respiratory infections. In manifest tuberculosis and non-specific pneumonitis these complaints were most marked. Weakness (70.6 per cent) and weight loss (69.5 per cent) were also prominent complaints, but generally were present after work stoppage had occurred. Chest pain, a difficult symptom to evaluate, was a complaint in 44.3 per cent of cases. True pleuritic pain was seldom present, localization being difficult. The majority complained of vague pains in the lower anterior portions of the chest, often substernally, probably in relation to the pleural adhesions. Hemoptysis was found in 35.8 per cent of cases and varied from blood streaking to massive hemorrhage. It was only slightly higher (43.5 per cent) in those cases with proved tuberculosis as compared to the non-tuberculous cases (34.4 per cent).

Findings on Physical Examination

The important findings on physical examination are shown in Table 6. The state of nutrition was good in 50 per cent of cases. In those classified as poor or fair there was a definite relationship

to associated disabling conditions such as tuberculosis, non-specific pneumonitis and malignancy. Nutrition was also poor in those with marked pulmonary function impairment per se. Obvious dyspnea at rest or orthopnea was present in 86 cases (22.9 per cent) with some degree of clubbing of the fingers in 4.8 per cent and curvature of the nails in 18.7 per cent. There was no attempt to determine the presence of pallor, but 21 cases (5.6 per cent) showed a marked degree of cyanosis. The presence of significant emphysema was suspected from the appearance of the chest in 272 cases (72.5 per cent) where a moderate to marked barrel-shaped appearance was present. Limitation of expansion was a constant and marked finding in all age groups, being two inches or less in 78.4 per cent of the cases. The degree of expansion was difficult to evaluate inasmuch as many showed a lifting motion of the entire chest rather than expansion, but which gave a definite increase in the recorded circumference. Frequently, roentgenographic examination revealed more aeration of the lungs on deep breathing than was to have been expected on measurements

TABLE 6

Findings on Physical Examination

	Number	Per cent
State of Nutrition		
Poor	86	22.9
Fair	101	26.9
Good	188	50.2
Obvious dyspnea at rest	86	22.9
Emphysematous Type Chest	272	72.5
Limitation of Chest Expansion (below 2 inches)	294	78.4
Average Inspiration—36 inches		
Average Expiration—35 inches		
Abnormal breath sounds	47	12.5
Localized moist rales	69	18.4
Musical rales	107	28.5
Clubbed fingers	18	4.8
Curvature of finger nails	70	18.7
Cyanosis	21	5.6
Cardiac arrhythmia	15	4.0
Cardiac murmurs	8	2.1
Peripheral edema	8	2.1

of the degree of expansion. The circumference of the chest at the nipple line averaged 36 inches on deep inspiration and 35 inches with deep expiration.

Percussion of the chest was not considered too reliable a means of examination and its value depended usually on the degree of emphysema. With marked emphysema, underlying processes could not be determined with accuracy. Alterations of the breath sounds, however, were considered significant and were found in 47 or 12.3 per cent of cases. The presence of localized moist rales, as noted in 18.4 per cent of cases, was considered most important, frequently suggesting associated tuberculosis or bronchiectasis. Musical or dry rales were found in 107 cases (28.5 per cent) usually related to the emphysema with superimposed non-specific secondary infection.

The cardiac and circulatory findings are recorded in Table 6. No attempt was made to determine heart size by physical examination, because emphysema often masked the borders of the precordium. Enlargement was found in 54 cases (14.4 per cent) during fluoroscopic and roentgenographic examination. Significant variations in the rate were present in 15 cases (4.0 per cent) but murmurs were heard only in 8 cases (2.1 per cent). Peripheral edema was found in 8 cases (2.1 per cent).

Response to Exercise Test

After completion of the history and physical examination the miner rested in bed for five minutes and the pulse, blood pressure, and respirations were recorded. The quality and rate of the pulse was generally normal (average 82) except in those cases with significant infection, especially tuberculosis, where the rate was usually elevated (average 94). The blood pressure was normal or consistent with the patient's age in all but 38 cases, averaging 124/76. In these 38 cases definite hypertension was noted after resting five to 10 minutes. The respiratory rate was normal (20 per minute or below) in only 122 cases (34.5 per cent), the majority (53.4 per cent) showing a rate of 21 to 28 per minute. Only 12.2 per cent showed a resting rate of 29 per minute or above.

There were 118 miners (31.2 per cent) who were not subjected to or could not complete the exercise test because of age factors, injuries, weakness, severe dyspnea or manifest pathological conditions which contraindicated its use. In the 257 cases where it was used, 46 (17.9 per cent) showed failure of the pulse to return to the normal range, and 72 or 28.0 per cent showed significant changes in the blood pressure. These changes were interpreted as showing some cardiac and circulatory embarrassment. The respiratory rate returned to the pre-exercise level in only 94 cases

(31.6 per cent). Of the remaining number, 106 (41.3 per cent) showed an increase up to four respirations per minute, 24 (9.3 per cent) an increase of five to eight, and 26 (10 per cent) an increase above nine.

Laboratory Findings

The significant laboratory findings are shown in Table 7. Varying amounts of sputum were obtained in all but 45 cases (12 per cent). In these cases examination of the gastric contents or bronchoscopic aspiration was resorted to. The cases classed as infected (tuberculosis, pneumonitis or other secondary infection)

TABLE 7

Significant Laboratory Findings

SPUTUM:								
Average amount in 24 hours—Non-infected cases							20.4 gms.	
Infected cases							41.2 gms.	
Positive for acid-fast bacilli							44 cases (11.7%)	
BLOOD COUNT (360 cases):								
Hb. in grams	No.	Pct.	RBC in Millions	No.	Pct.	WBC in Thousands	No.	Pct.
Below 10	5	1.4	2 - 3	5	1.4	Below 6	71	19.7
10 - 12	66	18.2	3 - 4	113	31.4	6 - 8	188	52.2
12 - 14	172	47.8	4 - 5	164	45.6	8 - 10	55	15.3
14 +	117	32.5	5 +	78	21.7	10 +	46	12.8
URINE:	No.	Pct.	Tuberculin Test (333 cases)				No.	Pct.
Albumin	63	16.8	Positive				209	89.5
Sugar	6	1.6	Negative				24	10.5
Pyuria	22	5.9	Other Blood Studies				No.	Pct.
Casts	24	6.4	Urea Nitrogen Above 20 mgs. %				30	8.0
Poor concentration	54	14.4	Serology (293 cases)					
Fasting Blood Sugar (334 cases)			Negative				279	95.2
Mgs. Pct.	No.	Pct.	Positive				14	4.8
Below 60	30	9.0	Proteins: 5.19 - 10.56 gms.					
61 - 80	191	57.2	Albumin: 2.2 - 6.98 gms.					
81 - 100	93	27.8	Globulin: 0.8 - 8.36 gms.					
101 - 120	14	4.2	Reversal of A G Ratio 20 (6.8%)					
120 +	6	1.8	Average Sedimentation Rate 35 mm. in one hour (Westersoren's method)					

showed the greatest amount of sputum, averaging 41.2 gms. in 24 hours. The non-infected cases averaged 20.4 gms. in 24 hours. In 44 cases, or 11.7 per cent, the sputum was positive for acid-fast bacilli. In all but seven of these cases the bacilli were readily recovered on examination of the plain smears. In these seven cases positive sputum was obtained on examination of the gastric washings in two cases and on bronchoscopic aspiration in five cases.

The hemoglobin, red cell and white cell findings showed marked variations depending on the length of time the patient had been disabled and the associated medical conditions. Generally, hemoglobin was above 13 grams and red cells above four million per cm. Marked compensatory polycythemia was seen very infrequently, although 21.7 per cent showed more than five million red cells per cm. Leucocytosis was not a feature in this series, only 12.8 per cent showing a white count above 10,000 per cm. In the cases showing associated nonspecific secondary infection the white count was generally normal.

Significant findings of the urine were noted in 123 cases (32.7 per cent) chiefly as regards the amount of albumin and poor concentration. Despite the presence of many debilitating medical conditions, the urinary output and concentration was adequate in all but 54 cases (14.4 per cent). In 38 cases (11.2 per cent) the urinary changes were sufficient to establish the diagnosis of chronic nephritis, despite the fact that an elevated urea nitrogen (above 20 mgs. per cent) was found in only 30 cases (8 per cent).

A constant finding was the persistently low fasting blood sugar, over 60 per cent of examinations being below 80 mgs. per cent. The cause of this has not been established, but it has been suggested that silicotic changes in the liver may play a part.

Wide variations of blood protein levels were noted, but a reversal of the albumin-globulin ratio was found in only 6.8 per cent of cases, usually when chronic nephritis was present. A positive serology was found in 4.8 per cent of cases which is somewhat higher than for the population at large.

Of the 233 miners who were tuberculin tested all except 10.5 per cent reacted positive to the first or second strength PPD. This incidence is greater than in similar age groups and may be related to the higher incidence of tuberculosis among coal miners because of the conditions favoring exposure to infection.

Electrocardiographic Findings

Electrocardiograms were done on 148 patients. Of these, 24 (16.2 per cent) showed evidence of right heart strain. This diagnosis was based on the following electrocardiographic changes: a deep S wave in leads I and III; a depressed and bowed down RST seg-

ment in lead III; tall peaked P waves in leads II and III, with inversion of the P waves in the precordial leads (the pattern of cor pulmonale); and small R and deep S waves in the precordial leads. The persistence of a small R and a deep S wave in the precordial leads CF_4 and CF_5 have been a most characteristic feature in these cases.

No correlation appeared to be present between the stage of anthracosilicosis as determined by the roentgenogram and the incidence of right heart strain, for evidence of this change was present in 32 per cent of those with first stage and in 29 per cent of those with third stage silicosis. However, there was a close correlation between right heart strain and the degree of emphysema. In those with a slight degree of emphysema, right heart strain was found in only 5 per cent of cases, whereas it was present in 30 per cent of those with moderate to advanced emphysema and in 61 per cent of those with far-advanced emphysema.

In general, right heart strain occurred more frequently in those cases where the resting mean arterial PO_2 was low. However, short induced periods of acute hypoxia produced only minimal electrocardiographic changes.

Fluoroscopic and Roentgenographic Findings

The fluoroscopic and roentgenographic findings are summarized in Table 8. Classification was based upon the system proposed by the Committee on Pneumoconiosis of the American Public Health Association (October 1933) in which the size of the nodulation determined the stage. The so-called linear and granular phases have been considered as normal or borderline, nodules up to 2 mm. in diameter as first stage, nodules up to 6 mm. as second stage and anything beyond 6 mm. as third stage, particularly where coalescence or conglomeration was present. Not all cases with definite silicosis showed this nodular pattern, some cases being characterized by linear fibrotic changes of varying degrees. These cases were classified as stage one or two according to the extent of involvement. In general, 61 per cent of those classified as first stage, 89 per cent of the second stage and only 7 per cent of the third stage were typical nodular in character. The majority (61 per cent) of those considered as third stage were of the conglomerate type.

In 168 cases (44.8 per cent) the roentgenographic picture was assymmetrical, but proved tuberculosis was present in only 23.8 per cent of these. In an additional 11.0 per cent other infection (non-specific pneumonitis) was present giving a total of 34.8 per cent with demonstrable infection. In the 37 cases (9.9 per cent)

in which cavitation could be readily demonstrated, all but 19.0 per cent were found to be in association with tuberculosis. Deviation of the trachea was present in 102 cases (27.1 per cent) being pulled to the right in 23.5 per cent and to the left in 3.6 per cent of cases.

Impaired motion of the diaphragm was present in all but 4.3 per cent, the rest varying from slight, moderate to marked in more or less equal proportions. Fluoroscopic examination may be more reliable in this determination than the routine roentgenograms depending upon the degree of cooperation of the patient. Diaphragmatic motion was often slow, due to fibrotic changes with loss of elasticity and bronchospasm, with prolongation of the expiratory phase.

Enlargement of the heart was seen in 54 cases (14.4 per cent) with prominence or actual enlargement of the right auricle in only 11 cases (2.9 per cent).

Medical Conditions Present

The occurrence of associated medical conditions in anthoracosilicosis is indicated in Table 9. It is considered that these conditions individually or in combination, were sufficient to produce disability in 186 cases regardless of the degree of pulmonary function impairment due to the silicosis per se.

TABLE 8

X-Ray and Fluroscopic Findings

	Number	Per cent
Stage of Anthracosilicosis:		
Normal or Borderline	36	9.6
1st Stage	46	12.3
2nd Stage	64	17.1
3rd Stage	229	61.0
Impaired Diaphragmatic Motion:		
None	16	4.3
Slight	129	34.4
Moderate	104	27.7
Marked	126	33.6
Assymmetrical Lesions	168	44.8
Proved Tuberculosis	40	23.8
Cavitation	37	9.9
Proved Tuberculosis	30	81.0
Enlarged Heart	54	14.4

The major causes for disability in this group (18.4 per cent) are related to cardiovascular disturbances. These included myocardial disease, coronary artery disease, auricular fibrillation, hypertensive heart disease and other conditions. Active pulmonary tuberculosis was present in 47 cases (12.5 per cent) as determined by recovery of acid-fast bacilli in the sputum of 44 cases and a history of positive sputum prior to admission in the other three cases. In 3 additional cases the history and roentgenogram sug-

TABLE 9

Significant Medical Conditions Found in 375 Cases of Anthracosilicosis

Diagnosis	Number	Per cent
Cardiovascular Diseases	69	18.4
Pulmonary Tuberculosis	47	12.5
Non-specific secondary infections	47	12.5
Arterial Hypertension	38	10.1
Chronic Nephritis	38	10.1
Bronchiectasis	14	3.7
Senility	13	3.5
Syphilis	12	3.2
Generalized Arteriosclerosis	11	2.9
Arthritis and other diseases of bone and muscles	9	2.4
Pneumonitis	8	2.1
Disabling injury	6	1.6
Bronchogenic Carcinoma	6	1.6
Other malignancy	4	1.1
Bronchial Asthma	4	1.1
Prostatitis	3	.8
Diabetes	3	.8
Non-tuberculous spontaneous pneumothorax	3	.8
Peptic ulcer	2	.5
Empyema with broncho-pleural fistula	2	.5
Lymphatic leucemia	1	.3
Adenoma of Pancreas	1	.3
Periarteritis nodosum	1	.3
Psychosis	1	.3
Septicemia (Friedlander's Bacillus)	1	.3
Apoplexy	1	.3
Congenital Atresia of lung	1	.3

gested a healed tuberculous lesion which would increase the incidence of tuberculous disease to 13.3 per cent. There were four additional cases with the findings suggestive of tuberculosis, but with the sputum persistently negative. Under non-specific secondary infection are listed those cases with extension of upper respiratory tract infection into the chest producing increase in cough, expectoration and dyspnea and musical rales on auscultation. The effect of this type of infection was chiefly to aggravate existing disability in a temporary manner. Only those cases showing a persistent elevation of the diastolic pressure above 100 were considered to have hypertension. All of the cases classed as chronic nephritis showed significant albuminuria, decrease in concentrating function and either casts or elevation of the blood urea nitrogen above 20 mgs. per cent. Bronchographic study with iodized oil was undertaken in 38 cases of suspected bronchiectasis. In 14, or 37 per cent of these, the presence of varying degrees of bronchiectasis was confirmed. However, in only seven of these cases was the bronchiectasis severe enough to be considered as playing a major part in the disability. In one case complete atresia of one lung was confirmed by bronchography. The diagnosis of syphilis in the 12 cases was based on persistently positive blood Wassermann and Kahn tests. The eight cases of so-called pneumonitis were due to non-tuberculous infection manifested by systemic symptoms and localized changes on the x-ray which gradually resolved. In one instance the infection progressed and the patient died. Massive infection was found at autopsy with no evidence of tuberculosis.

A total of 43 cases received bronchoscopic examination. This was performed routinely in all instances where a new growth was suspected. There were four cases of bronchogenic carcinoma diagnosed bronchoscopically and two cases surgically. In addition, there were four other cases of neoplastic disease: carcinoma of the larynx, esophagus, spine and plasma cell myeloma.

Tests for allergy disclosed that only four cases (1.1 per cent) had true allergic bronchial asthma although the complaint "asthma" was common. Four cases were admitted with non-traumatic spontaneous pneumothoraces. In only one of these cases was associated active pulmonary tuberculosis present. There were two cases with massive empyemas and bronchopleural fistulae, one being due to carcinoma of the lung.

Correlation with Pulmonary Function Studies

In the 375 cases under consideration, disability in 186 cases (49.5 per cent) was complicated by one or more infectious, metabolic, or degenerative medical conditions. However, in 189 cases

no demonstrable disabling medical condition was present, and silicosis was regarded as producing the main disability on a pulmonary basis. The degree of pulmonary function impairment was evaluated by one of us (H.L.M.) from physiological tests performed on 150 of these cases and the results correlated with the clinical impression. The amount of emphysema and the degree of pulmonary impairment at time of admission were estimated on the basis of history, physical examination and exercise tolerance test. The clinical findings were then compared with the results of the pulmonary function studies.

In these 150 cases the chief cause of work stoppage was dyspnea. Table 10 shows the length of time dyspnea was present before work stoppage. In about 60 per cent of cases this was present for a period of three years or more before disability was sufficient to cause work stoppage.

Table 11 shows a comparison of the degree of emphysema predicted after physical examination and that determined by estimation of the residual air. The correct degree of emphysema was

TABLE 10

150 Cases with Pulmonary Function Impairment Per Se

Main Complaint — dyspnea in 129 or 86 per cent

Length of dyspnea before work stoppage:

	Number	Per cent
up to 1 year	20	13.6
1 - 2 years	33	22.0
2 - 3 years	3	2.0
3 - 4 years	31	20.4
4 - 5 years	18	12.0
above 5 years	45	30.0

TABLE 11

Degree of Emphysema in 150 Cases

Degree of Emphysema	Predicted by Physical Examination		Based on estimation of Residual Air		Correctly Predicted	
	No.	Pct.	No.	Pct.	No.	Pct.
None	10	6.7	28	18.6	7	25.0
Slight	37	24.6	30	20.0	11	36.7
Moderate	38	25.3	40	26.8	15	37.5
Marked	65	43.4	52	34.6	37	71.1

only predicted in 70 of the 150 cases (46.7 per cent). In these cases the greatest accuracy was in respect to the presence of marked emphysema where the correct degree was estimated in 71.1 per cent of cases and the least accuracy in the absence of emphysema where only 25.0 per cent was correctly predicted.

In Table 12 can be seen the correlation between predicted and actual impairment in 122 cases which were intensively studied. Of these, only 60 (49 per cent) were correctly predicted. The greatest accuracy occurred in cases with far-advanced disability with a large decrease in ventilatory measurements. If the ventilatory impairment was severe as manifested by decreased vital capacity, decreased maximum breathing capacity and increased residual air, the degree of impairment was more readily determined by clinical examination.

Table 13 shows that very little relation exists between the degree of function impairment, stage of silicosis and the length of exposure. All degrees of impairment occurred in all stages of silicosis and in all exposure groups.

TABLE 12

Function Impairment in 122 Cases

Degree of Impairment	Predicted by Physical Examination		Based on Function Studies		Correctly Predicted	
	No.	Pct.	No.	Pct.	No.	Pct.
None	2	1.6	0		0	
Slight	31	25.4	20	16.4	10	50.0
Moderate	29	23.7	39	32.0	15	38.5
Advanced	11	9.1	29	23.7	5	17.5
Far Advanced	49	40.2	34	27.9	30	88.2

TABLE 13

Pulmonary Function Impairment in Relation to Stage of Silicosis and Length of Exposure

Degree of Impairment as determined by Function Studies		Stage of Silicosis				Length of Exposure in Years				
	No.	None or Borderline	1st	2nd	3rd	0-10	11-20	21-30	31-40	41-50
None										
Slight	20	5	3	7	5	1	5	7	7	
Moderate	39	4	4	6	25	1	2	16	15	5
Marked	29		5	4	20		1	11	12	5
TOTAL	34	3	3	7	21		3	13	12	6

Discussion

An accurate evaluation of disability in anthracosilicosis requires the consideration of all factors involved and the correlation of symptoms, signs, roentgenological and laboratory examinations. The presence of active pulmonary tuberculosis may constitute total disability, but the pulmonary measurement may not be greatly impaired. Associated medical conditions must be evaluated, therefore, in the light of the basic pathology present and the influence on pulmonary function. The diagnosis clinically of tuberculosis, cancer, cardiac disease and the other degenerative processes can usually be made readily; however, the primary consideration may not be the degree of pulmonary function impairment per se, but the presence of the disease itself. As previously mentioned, in approximately 50 per cent of the cases studied the medical conditions present were sufficiently disabling to cause work stoppage, and this type of disability was usually readily determined by clinical studies.

Adequate physiological studies of pulmonary function require measurements on ventilation, the degree of emphysema and the respiratory gas exchange both at rest and during exercise.[5] Factors reducing the arterial oxygen saturation in anthracosilicosis may be grouped as follows:

1) *Ventilation:* decreased maximum breathing capacity and decreased vital capacity.

2) *Emphysema:* increased residual air, with the residual air per cent of total lung volume increased.

3) *Ventilation Efficiency:* decreased O_2 uptake and CO_2 addition to air breathed.

4) *Distribution:* unequal alveolar aeration and perfusion. The above factors may be involved in anthracosilicosis in varying degrees and combinations, hence the limitations in estimating function impairment from a clinical examination inasmuch as only marked decreases in ventilation and advanced degrees of emphysema are commonly recognized. The degree of pulmonary function impairment is difficult to estimate from clinical examination when the difficulty is primarily the respiratory gas exchange.

In the absence of pulmonary function studies, there must be definite reliance upon the history, physical examination, response to exercise tests and the roentgenographic examination. While the history will indicate the severity of disability, it may be misleading. A marked disparity between the complaints and the actual degree of impairment was not uncommon and the degree of pulmonary function impairment frequently differed although the degree of dyspnea appeared to be the same.

Emphysema is usually regarded as a chief factor in the production of disability in anthracosilicosis. The presence of emphysema clinically is determined principally from the physical examination and the roentgenogram. The term emphysematous type chest is used when the anterior-posterior diameters of the chest are increased (barrel-shaped) and generally the degree of emphysema is believed related to the degree of change. The true degree of emphysema from this observation was difficult to predict in more than 50 per cent of cases, except in the marked cases where the percentage is slightly higher (Table 14).

The step-up exercise test was of limited value in determining pulmonary function impairment. Some information may be obtained on the cardiac and respiratory reserve, but interpretation of the results are very difficult and may be erroneous for evaluating pulmonary function. In general, absence of circulatory embarrassment was indicated when the pulse and blood pressure were within normal limits before exercise and returned to normal within a two minute period of rest following exercise. Similarly, absence of respiratory embarrassment may be indicated when the respiratory rate was normal before and after exercise and when the expiratory phase was not unduly prolonged. In the group of cases where the test was completed, approximately 28 per cent showed some cardiac and circulatory embarrassment, whereas about 70 per cent showed some respiratory embarrassment on the above basis. However, there was no constant relationship between the increase in respiratory rate and the degree of emphysema or the degree of pulmonary function impairment, except in those cases where the increase in respiratory rate was above 9 (Table 15). In a group of 52 cases where the respiratory rate returned to the pre-exercise level, all degrees of emphysema and function impairment were present in about equal proportion. The exercise test appears to have a very limited value in determining the degree of emphysema and function impairment.

TABLE 14

Prediction of Degree of Emphysema in Emphysematous Type Chest

Barrel-Shaped Appearance			Degree of Emphysema Correctly Predicted	
	No.	Pct.	No.	Pct.
None	25	12.7	12	48.0
Slight	27	13.5	12	43.5
Moderate	80	40.8	36	45.0
Marked	65	33.0	38	58.5

Inclusion of the fluoroscopic findings and roentgenogram in determining emphysema and disability will aid in a more accurate evaluation. A marked degree of emphysema was generally readily detected by roentgenological studies, but an occasional case may be missed as unsuspected marked degrees of emphysema have been found.

TABLE 15

Relationship Between Exercise, Degree of Emphysema and Function Impairment

Increased Respirations	No.	EMPHYSEMA (Per cent) None	Slight	Moderate	Marked
None	52	27.0	27.0	21.0	25.0
1 - 4	55	20.0	16.3	36.4	27.3
5 - 8	19	26.3	42.1	10.5	21.1
9 -	8			37.6	62.4

TABLE 15 (Continued)

Increased Respirations	No.	FUNCTION IMPAIRMENT (Per cent) None	Slight	Moderate	Advanced	Far Advanced
None	52		21.2	32.7	25.0	21.1
1 - 4	55		20.0	41.8	14.5	23.7
5 - 8	19		21.1	42.0	15.8	21.1
9 -	8			12.5	37.5	50.0

SUMMARY AND CONCLUSIONS

The clinical features of disability in an unselected group of 375 hard coal miners with various stages of silicosis have been studied. The clinical findings in 150 cases were correlated with pulmonary function studies.

Evaluation of disability requires recognition and consideration of all factors which may contribute to the function impairment. In 49.5 per cent of cases, disability was related to one or more infectious, metabolic or degenerative medical conditions. Cardiovascular disease was seen most frequently, occurring in 18.4 per cent of cases. Active pulmonary tuberculosis was present in 12.5 per cent. Right heart strain occurred in 16.2 per cent and showed a definite relationship to the degree of emphysema.

In 50.5 per cent of cases disability was due to pulmonary function impairment per se, related to ventilatory changes, the degree of emphysema and the respiratory gas exchange. The factors involved were multiple in most cases.

A fair estimate of the degree of function impairment can be

obtained by the ordinary clinical methods when the major factors in the impairment are related to decreased ventilation and increased emphysema. Clinical examination will not reveal impairment due to arterial blood oxygen unsaturation.

In a significant number of cases the degree of function impairment was not proportional either to the amount of silicosis or to the length of exposure.

RESUMEN Y CONCLUSIONES

Se ha presentado un estudio clínico de incapacidad, en varios estados de la silicosis, en un grupo no seleccionado de 375 mineros de carbón. Los síntomos clínicos en 150 casos, fueron corroborados con estudios de la función pulmonar.

La evaluación de la incapacidad, requiere conocimiento y consideración de todos los factores que contribuyen al empeoramiento de la función. La incapacidad en 49.5 por ciento de los casos, estaba relacionada a un proceso infeccioso, metabólico o degenerativo. Enfermedades cardio-vasculares ocurrieron en el 18.4 por ciento de los casos. La tuberculosis pulmonar activa estubo presente en el 12.5 por ciento. Lesiones del corazón ocurrieron en el 16.2 por ciento y provó una relación definitiva con el grado de enfisema.

En el 50 por ciento de los casos la incapacidad fué debida exclusivamente al empobrecimiento de la función pulmonar, relacionado con los cambios en la ventilación, el grado de enfisema y el intercambio gaseosa de la respiración. Los factores comprometidos en la mayoria de los casos eran varios.

Un resultado bastante aproximado del grado de la incapacidad de la función se puede obtener con los métodos clínicos ordinarios, cuando los factores de la incapacidad estan relacionados con una disminución en la ventilación y un aumento en el emfisema. El exámen clínico, no revelará, la incapacidad debida a la falta de saturación del oxigeno en la sangre.

En un gran número de los casos, el grado de incapacidad de la función no estubo en proporción con la cantidad de silicosis o con el tiempo de exposición.

REFERENCES

1 Darling, R. C., Cournand, A. and Richards, D. W. Jr.: "Studies on Intrapulmonary Mixture of Gases: An Open Circuit Method for Measuring Residual Air," *J. Clin. Invest.*, 19:609, 1940.

2 Motley, Hurley L., Lang, Leonard P. and Gordon, Burgess: "Total Lung Volume and Ventilation Measurements in One Hundred Anthracite Coal Miners with Respiratory Complaints," *Am. Rev. of Tuberc.*, 59: 270, 1949.

3 Motley, Hurley L., Lang, Leonard P. and Gordon, Burgess: "Total Lung Volume and Maximal Breathing Capacity (MBC) in Pulmonary Emphysema After Repeated Periods of Intermittent Positive Pressure Breathing (IPPB)," *J. Aviation Med.*, 19:346, 1948.

4 Motley, Hurley L. and Lang, Leonard P.: "The Nature of the Breathing Impairment in Anthracosilicosis," *Federation Proceedings*, 8:114, 1949.
5 Motley, Hurley L., Gordon, Burgess, Lang, Leonard P. and Theodos, Peter A.: "Pulmonary Function Impairment in Anthracosilicosis," *J.A.M.A.*, 1949. In press.

Discussion

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This report by Dr. Theodos and his associates is of unusual significance. It is representative of a new trend in the study of silicosis, an increased emphasis on the disturbance of function. Until recently practically all the studies were of a clinical and roentgenologic nature. Observers are universally in agreement that there is no constant relation between the length of exposure to silica and the x-ray findings in different individuals, and again between the x-ray findings and the symptomatology. However, there is unanimity that the common denominator in all cases and the general reason for stoppage of work is dsypnea. There are two major reasons for the dyspnea in silicosis: The first is irregular fibrosis of the lungs involving the pulmonary capillary-bed as has been demonstrated by Cole. There is stenosis or closure of some capillaries and marked dilation and stagnation in others with impairment of gas exchange. This may account for some of Dr. Theodos' cases which showed arterial oxygen unsaturation in the absence of abnormal ventilation and emphysema. The second common cause of dyspnea is emphysema with loss of respiratory surface. It should be noted that the diagnosis of emphysema is not always accurate even with the help of good x-ray films. The residual air determinations used in the present study are useful in deciding on the degree of emphysema. It would be of interest to know if the authors have attempted to correlate these results with the diffusion capacity test by means of the rebreathing bag reported by Ornstein.

One cannot help admiring the thoroughness of the survey made in each case of this series, and wishing that such methods could be applied more widely. Apart from dust prevention measures, what is needed most for the dusty industries is a simple and inexpensive series of tests which are uniformly accepted throughout the country and which can be done on an out-patient basis in an hour or two at the most and can be repeated semi-annually. In this way accurate inventory can be kept of the respiratory functional state of each employee. Thus the individual who shows a significant or sudden drop in respiratory reserve may be warned and

shifted to a safer job or occupation. I believe that studies like the present one are valuable in arriving at that goal.

I should like to touch on one more point. Dr. Theodos and his associates found a rather high incidence of tuberculosis (12 per cent). While it is commonly accepted that silicosis predisposes to tuberculosis I don't think that the case is completely proved or universally true. Last year I made a survey of approximately 700 employees in an iron foundry and found some 90 cases of silicosis. It was of interest that not one of these had tuberculosis that could be demonstrated. Inquiry from public health sources revealed the fact that tuberculosis is relatively low in that community. I believe that economic conditions, housing, opportunities for contact and other epidemiologic factors are probably more important than the silicosis in predisposing to tuberculosis.

LOUIS L. FRIEDMAN, M.D., F.C.C.P.
Birmingham, Alabama

I have enjoyed listening to Doctor Theodos' presentation on the clinical and laboratory evaluation of disability in anthracosilicosis. Both by design and chance I have also had the opportunity and privilege of seeing many cases of anthracosilicosis in my section of the country. Without reservation, I can agree with the speaker that the evaluation of disability in anthracosilicosis is a most difficult problem. From the investigations in progress today it appears that greater reliance will have to be placed on proved laboratory methods of reliably determining pulmonary function. I am sure that Doctor Theodos and his group are contributing much effort and information in that direction.

In dealing with patients suffering from anthracosilicosis, one is duly impressed by the frequent discrepancy between the x-ray findings of the chest and the clinical and other laboratory studies. Frequently an x-ray with very little roentgenologic evidence of pulmonary involvement with anthracosilicosis belongs to a patient with obvious pulmonary disability. Likewise, many roentgenograms with diffuse fibrosis belong to patients who do not manifest any pulmonary disability, either subjectively or objectively. With your indulgence, I would like to take this opportunity to comment on the present classification of silicosis which accepts the pulmonary nodule as a basic prerequisite. In anthracosilicosis this classification is useless because the pattern as seen in the x-ray films of the patients suffering from this disease, by far and large, are not covered in Sampson's classification. In the near future some effort should be made to convene a group of physicians interested in the problem of anthracosilicosis for the purpose of developing a

classification based on x-ray findings which will be more applicable to this particular medicolegal problem. It is my opinion that anthracosilicosis in certain stages is a very disabling disease, but I also am of the opinion that anthracosis, without complicating silicosis, may also be less innocuous than we have been taught to believe. Of course, proof of this latter contention must await the results of more detailed studies and autopsy information.

In general, I am in full agreement with all of Doctor Theodos' remarks. However, I do not find the incidence of tuberculosis or hemoptysis to be quite as great in my series of patients suffering from anthracosilicosis. On the other hand, the coexistence of allergic bronchial asthma in the group of bituminous coal miners which we have studied to date is present in about 12 to 14 per cent of the cases.

Doctor Theodos and his group deserve to be complimented for the excellent piece of research which they are conducting. I, personally, anticipate important contributions and changing concepts regarding anthracosilicosis as a result of their research. It is, indeed, unfortunate that the manuscript as written was not presented in full at this meeting. (Slides were presented to demonstrate these remarks).

A Case of "Lymphangitic Carcinoma" of the Lung Diagnosed by Sputum Smear Examination

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"Lymphangitic carcinoma"—carcinoma of the stomach or other visceral organs with diffuse pulmonary lymphatic extension was first described and reported by Andral,[1] and subsequently by many others. An excellent review of this subject with presentation of an additional five cases was published by Wu[2] in 1936.

Lymphangitic carcinoma of the lung is frequently difficult to diagnose. The clinical and x-ray findings closely simulate inflammatory processes or severe pulmonary congestion. The primary lesion frequently produces no symptoms or other findings. We wish to present a case diagnosed by the demonstration of neoplastic malignant cells in the sputum. To our knowledge, this has not been reported in the cases of "lymphagitic carcinoma."

CASE REPORT

The patient was a white female 43 years old who developed severe cough and dyspnea about January 5, 1948. Approximately two weeks later she complained of pain in the left chest which lasted for several days. Anorexia, malaise, a low grade fever and night sweats subsequently appeared. The cough became progressively worse and produced only small amounts of white, frothy sputum. Dyspnea became severe. She was first seen by a physician on January 19, 1948. Scattered wheezes were heard over both lung fields; an acute respiratory infection was suspected and hospitalization was recommended.

The patient was hospitalized on February 3, 1948. No additional history of importance was obtained, and she had no complaints on entry other than those mentioned. Her past health had been excellent, and there had been no loss of weight prior to her illness.

Examination on admission showed marked dyspnea and moderate cyanosis. There were frequent paroxysms of coughing which yielded small amounts of white, frothy sputum. She had a temperature of 98 degrees F., pulse of 90, respirations 24, and blood pressure of 130/90. General physical examination revealed normal findings except for the chest where tactile fremitus, resonance and breath sounds were diminished on the left. A few scattered coarse rales were heard over the right

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lung posteriorly. Laboratory examinations showed: RBC 5,000,000, hemoglobin 14 grams, WBC 15,000 with moderate left shift in the Schilling differential. The blood culture and the urine analysis were negative. The sputum examination disclosed no predominant organisms and was negative for acid-fast bacilli. The EKG showed only sinus-tachycardia. The chest film revealed accentuated hilar shadows, a diffuse, generalized increase in the peribronchial markings with obliteration of the left costophrenic sinus presumed to be the result of pleural fluid (Fig. 1).

Course in the Hospital

The patient became steadily worse. The dyspnea and cyanosis increased; and soon she began to show low grade fever with a daily average maximum of about 100 degrees F., never exceeding 101 degrees. On February 7, 1948, 500 cc. of clear serous fluid were removed from the left pleural space. This fluid was not examined for malignant cells and no growth was obtained on ordinary culture media. Since tuberculosis was suspected and supported by a positive tuberculin test, a guinea pig was inoculated with this pleural fluid. Blood cultures were repeatedly negative.

On February 21, 1948 the sputum was examined for neoplastic cells, and numerous signet ring colloid cells, with occasional mitotic figures, were seen. A diagnosis of Krukenberg carcinoma was entertained (Fig. 2). Subsequently, similar cells were found in the pleural fluid (Fig. 3).

No new findings of importance were noted, except that fluid developed in the right pleural space. The patient's condition gradually became worse, and she died on March 11, 1948.

Gross Pathological Findings: External examination of the body was non-contributory.

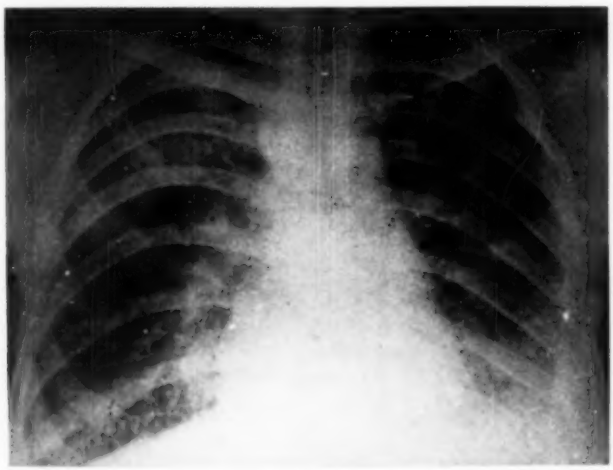


FIGURE 1: Chest film revealing accentuated hilar shadows, a diffuse generalized increase in the peri-bronchial markings with obliteration of the left costo-phrenic sinus presumed to be the result of pleural fluid.

Body Cavities: The pericardial cavity contained about 150 cc. of blood-tinged cloudy fluid, and the lining was roughened and injected. The right pleural cavity contained about 1,000 cc. of air and about 1,000 cc. of blood-tinged fluid. The parietal pleurae were hemorrhagic, rough, slightly thickened and flecked with small pale elevated patches, the largest of which was one to two mm. in diameter. The peritoneal cavity contained no fluid, and the serous lining was of normal appearance throughout.

Body Organs: The heart was negative, except for the parietal and visceral pericardia which were roughened and slightly thickened, especially about the root of the aorta and pulmonary vessels. The right lung weighed 660 grams, the left 600 grams. Both lungs were of normal size and shape and showed generalized consolidation. The external surface was roughened, hemorrhagic and showed slightly elevated white striae directed toward the hilus. Sections through the lungs revealed generalized consolidation with hemorrhagic cut surfaces flecked with whitish nodules which varied from less than 0.5 to 3 mm. in diameter. These were prominently associated with the vasculature and bronchial tree. No fluid exuded from the cut surfaces. The peribronchial nodes were enlarged to about 1.5 cm. in diameter. These were firm and on cut section the surface was white and flecked with black pigment.

The stomach was collapsed, enlongated, pale and contracted, measuring about 8 cm. in its greatest diameter. Lymph nodes were palpable in the hepato-gastric ligament along the lesser curvature of the stomach near the cardiac end (paracardial nodes). On section these were pale and firm. Longitudinal section through the stomach along the lesser curvature revealed about 100 cc. of brown granular fluid in the lumen. The wall was of normal thickness throughout; the mucosal surface and rugae appeared normal in size and shape, except at the extreme anterolateral cardiac end where the rugae ended abruptly about 5 cm. from the esophageal orifice. The mucosa of this area was slightly hemorrhagic and roughened, grossly suggesting early ulceration. Section through this area revealed slight thickening of the mucosa with adherance to the muscular coat at one point, suggesting tumor or inflammatory fixation of the mucosa to the muscularis. All other organs were grossly negative.

Microscopic Examination

Sections of the involved cardiac portion of the stomach revealed a slightly thickened mucosa. The normal glandular arrangement was distorted, the mucosa being composed of glands which varied in size and shape, and which were lined by anaplastic, pleomorphic cells showing occasional mitotic figures. In some areas the tumor cells had infiltrated the supporting connective tissue of the mucosa, singly or in small clusters. The supporting stroma was fibrous, and in one zone there was extension of the tumor through the muscularis mucosae into the submucosa. The muscularis was not involved (**Fig. 4**).

Sections of the paracardial lymph nodes along the lesser curvature of the stomach revealed tumor tissue composed of glands similar to those described in the stomach tumor. Other areas showed sheets or clusters of signet ring cells, and still other areas were composed of flattened epithelial tumor cells. The signet ring cells were predominantly found in the lymphatic channels or in the subcapsular sinus.

Numerous sections of the lungs revealed a thickened fibrous pleural lining. There was marked signet ring cell engorgement of all the sub-

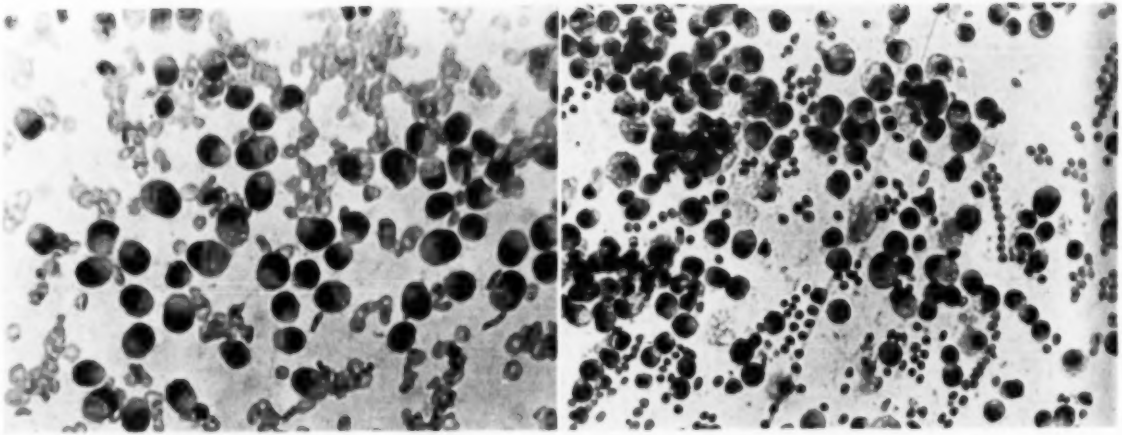


FIGURE 2 FIGURE 3

Fig. 2: Sputum smear fixed with ether-alcohol and stained with hematoxylin-eosin.—*Fig. 3*: Pleural fluid smear prepared as Figure 2. Note similarity of these cells and cells of Figure 1.

FIGURE 4: Carcinoma of stomach involving mucosa with extension through muscularis mucosae into submucosa but not involving muscularis.

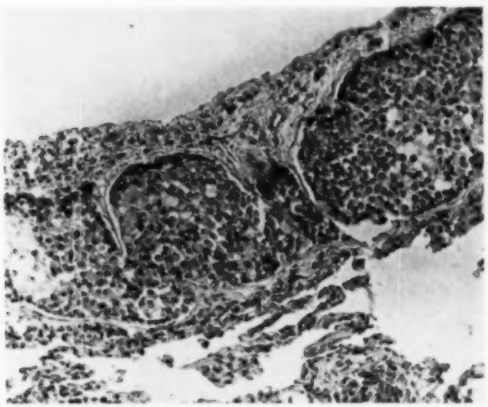


FIGURE 5: Section of lung showing engorgement of subpleural lymphatics with signet-ring tumor cells.

pleural lymphatics and all other lymphatics of the lung parenchyma (Fig. 5). In some zones the tumor simulated colloid carcinoma, and in other areas the picture resembled that of Krukenberg tumor. Occasional tumor cells were noted in the alveolar spaces, but no evidence of vascular or alveolar wall invasion was noted.

Sections of the peribronchial nodes showed metastatic involvement similar to that described in the paracardial lymph nodes.

Sections of the root of the aorta revealed tumor invasion of the adventitia and external layers of the media.

Sections of liver, gall-bladder, spleen, adrenals, kidneys, uterus, tubes and ovaries failed to show any evidence of tumor involvement.

Comment

Development of tuberculosis by the guinea pig inoculated with pleural fluid (left) was a puzzling feature of this case. Careful examination of all the sections from the patient failed to reveal any evidence of tuberculosis. It was not possible to ascertain whether the positive guinea pig reaction was the result of an undiscovered focus in the lung which shed bacilli into the pleural fluid or whether a laboratory error resulted in a false positive.

This case is of interest because it shows the possibility of demonstrating metastatic as well as primary carcinoma of the lung by cytological study of the sputum. The signet ring character of the cells found in the sputum, and the diffuse nature of the involvement radiographically suggested the probability that the lesion was metastatic rather than primary. The frequency with which malignant cells might appear in the sputum in cases of metastatic carcinoma of the lung is not known, but this case suggests that the possibility should be borne in mind.

It should also be emphasized that the primary focus in the stomach was grossly inconspicuous and found only by careful examination. There were no clinical signs or symptoms suggesting the presence of a lesion, and it probably could not have been diagnosed by radiogram.

SUMMARY

A case of lymphangitic carcinoma of the lung with the inconspicuous primary origin in the stomach is presented. The diagnosis was made first by sputum examination and radiogram and was later confirmed by pleural fluid examination and autopsy. The possibility that malignant cells may be found in the sputum in metastatic as well as in primary tumors of the lung is pointed out.

RESUMEN

Se presenta un caso de carcinoma linfangitico del pulmón, con un origen primitivo pero velado, en el estómago. El diagnóstico

fué hecho primero por el exámen de los esputos y radiografías, el cual fué confirmado mas tarde por los exámenes del líquido pleural y la autopsia.

Se recalca la posibilidad, de encontrar células malígnas en los esputos, en lesiones metastásicas lo mismo que en las lesiones primitivas del pulmón.

REFERENCES

1 Andral, G.: *Precis de Path. Anatomy*, 2:444, 1829. (Quoted from Wu, 1936).

2 Wu, T. T.: "Generalized Lymphatic Carcinosis of Lungs," *Journal of Pathology and Bacteriology*, 43:61, 1936.

An Analysis of Tuberculous Infection From Birth to Old Age; Its Relationship to Clinical Tuberculosis and Deaths from Tuberculosis*

PAUL W. BEAVEN, M.D.
Rochester, New York

Introduction

During the years 1942-43-44 the Tuberculosis and Health Association of Rochester, New York, conducted a tuberculosis case finding program among the factory workers in the community. The method which was used during this period was to apply the Vollmer patch test to such personnel as could be induced to have it done. The test material was applied by a nurse and in 48 hours was removed; 48 hours later it was read by a physician. The same nurse and the same physician made all the observations. In this period the test was offered to 11,728 men and women, and 9,252, or 78 per cent, availed themselves of it. Of these 9,252 persons, 5,422 or 59 per cent were reactors. Through intensive effort on the part of the staff of the Association, practically every one of the reactors was examined either by the x-ray laboratory at Iola Sanatorium or by private roentgenologists cooperating with the program. After 1944 this program was abandoned in favor of the mass x-ray survey using the miniature film mobile unit.

These data on more than 9,000 men and women evenly distributed through adult life provided adequate material for a review of infection with tuberculosis in the older age group.

Tuberculin Tests Among Children in Years 1942-43-44

It was felt that if these data were augmented by similar observations on children, even though they were not a part of the survey, it would provide a complete, and so more significant record of tuberculous infection in the whole population during this period. Accordingly the records of 3,000 children through the age of 14 who were admitted to Strong Memorial and Rochester Municipal Hospitals during the years 1942-43-44 were analyzed, noting the tuberculin reactions.

The age groups given in tuberculin test (arranged in 15 year

*This essay received the Paine Drug Company Award by the Rochester Academy of Medicine.

spans for reasons made clear later in this paper) were of approximately the same size, except in that group over 60 years of age (See Table 1).

Clinical Cases of Tuberculosis and Reported Deaths From Tuberculosis Occurring in Rochester in 1942-43-44

The cases of clinical tuberculosis reported to the Rochester Health Bureau during the years 1942-43-44 were also analyzed. These cases were arranged by sex, and divided in 15 year age groups.

The deaths from tuberculosis in Rochester during the years of this study were also tabulated by sex and similar age groups.

The population of Rochester was also analyzed in a similar manner, noting the sex and the number of persons in each 15 year age group (See Table 2).

Knowing the number of individuals in the community, the number who were infected, those showing clinical disease, and the numbers who died of tuberculosis, in each instance by sex and by age group, we might be able to make generalizations about the relationship of these data.

TABLE 1

The number and Per cent of Positive Reactors in Those Given the Tuberculin Test, Arranged in 15 Year Age Groups and by Sex

Age Groups in Years	Sex and Total	Number Tested	No. Tuberculin Reactors	Per cent Tuberculin Reactors
FROM STRONG MEMORIAL AND MUNICIPAL HOSPITALS				
0	M	1593	31	1.9
to	F	1407	9	0.64
14	T	3000	40	1.3
FROM INDUSTRIES				
15	M	760	236	31.
to	F	1336	337	25.2
29	T	2096	573	27.0
30	M	1421	962	67.0
to	F	1952	1105	56.6
44	T	3373	2067	61.0
45	M	1759	1453	82.6
to	F	1424	933	65.4
59	T	3183	2386	74.0
60	M	456	320	70.0
+	F	144	76	52.8
	T	600	396	66.0

TABLE 2

Number of Clinical Cases of and Deaths from Tuberculosis Occurring in the Total Population and also Assumed Infected Population of Rochester, 1942-43-44

Age Groups in Years	Sex and Total	Total Population Rochester U. S. Census 1940	Population of Rochester Assumed to Have Positive Tuberculin Infection	— — CLINICAL CASES — — Number Reported 1942, 1943 1944	Case Rate Per 10,000 Population	Case Rate Per 1,000 Infected Population	— — — DEATHS — — — Number Reported 1942, 1943 1944	Case Rate Per 10,000 Population	Case Rate Per 1,000 Infected Population
0	M	30,605	596	29	9.5	48.6	7	2.3	11.7
to	F	29,932	192	33	11.0	172.0	3	1.0	15.6
14	T	60,537	788	62	10.2	78.7	10	1.7	12.7
15	M	41,433	12,866	173	41.8	13.4	20	4.8	1.56
to	F	44,519	11,229	179	40.2	15.9	32	7.2	2.85
29	T	85,952	24,095	352	41.0	14.6	52	6.1	2.16
30	M	34,596	23,421	181	52.4	7.7	57	16.5	2.44
to	F	37,499	21,227	81	21.6	3.8	36	9.6	1.69
44	T	72,095	44,648	262	36.3	5.9	93	12.9	2.08
45	M	32,399	26,810	216	66.6	8.1	81	25.0	3.02
to	F	32,751	21,458	82	25.1	3.8	26	7.9	1.21
59	T	65,150	48,268	298	45.7	6.2	107	16.4	2.22
60	M	18,359	12,591	120	65.5	9.5	76	41.4	6.04
+	F	22,622	11,939	47	20.8	3.9	20	8.9	1.67
	T	40,981	24,520	167	40.8	6.8	96	23.4	3.92
GRAND TOTAL		324,715	143,227	1141			358		

Tests Arranged in Five Year Age Span

In order to get a clearer picture of the incidence rate of tuberculous infection at different ages, the span of life was first analyzed in five year groups (See Table 3).

This narrower grouping gives a better picture because the interval is shorter. It could not be used in relationship to clinical cases and deaths from tuberculosis because in the latter there often were found so few cases in a five year period that the number would have had no statistical significance.

TABLE 3

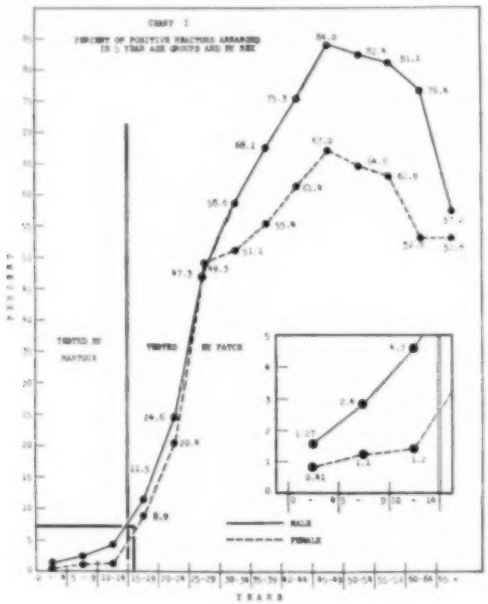
The number and Per cent of Positive Reactors in Those Given the Tuberculin Test, Arranged in 5 Year Age Groups and by Sex

Age Groups in Years	Sex	Number Tested	Number Positive Tuberculin Reactors	Number Positive Tuberculin Reactors
FROM STRONG MEMORIAL AND MUNICIPAL HOSPITAL				
0-4	M	1025	13	1.27
	F	971	4	0.41
5-9	M	336	8	2.4
	F	270	3	1.1
10-14	M	232	10	4.3
	F	166	2	1.2
FROM INDUSTRIES				
15-19	M	234	27	11.5
	F	372	33	8.8
20-24	M	175	43	24.6
	F	593	121	20.4
25-29	M	351	166	47.3
	F	371	183	49.3
30-34	M	435	255	58.6
	F	511	261	51.1
35-39	M	489	333	67.5
	F	689	382	55.3
40-44	M	497	374	75.3
	F	752	462	61.4
45-49	M	608	511	84.0
	F	718	481	67.0
50-54	M	659	543	82.4
	F	447	289	64.6
55-59	M	492	399	81.1
	F	259	163	62.9
60-64	M	309	236	76.5
	F	108	57	52.8
65 +	M	147	84	57.2
	F	36	19	52.8

It is seen in Chart I (compiled from data found in Table 3) that infection in the first 14 years of life is relatively negligible in this community at the time of the study. The greater incidence in the male in this group is observed here and is great enough to have statistical significance. The rise in the number of those infected after the age of 15 is abrupt, and the maximum percentage is reached at approximately 50 years of age. While there is a slightly greater number of males infected from 15 to 29 years of age, the difference may not be appreciable. But after the age of 30 the difference is marked and highly significant.

The reason for the percentage decline after the age of 50 is not known. The probable reason is that the skin of older people does not react as well as in the younger group. It might be felt that this is true in this study because the Patch test was used. This is, however, the same observation that Aronson* made in testing with P.P.D. older adults in a group observed by him in Alabama. Further evidence that older age affects skin reactivity lies in the fact that at the time of this study a group of 161 people in an Old Age Home (not included in this study) were

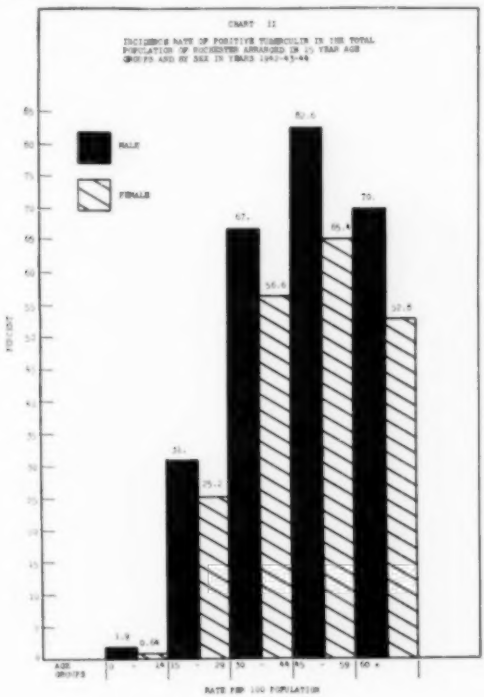
*J. D. Aronson, "Further Studies on the Incidence of Tuberculous Infection of Some Rural Communities of the South," *Am. Rev. Tuberc*, 28:5, 1933, pp. 62-67.



tested. They were all over 70 years old. Among them the males were more often infected, and the number of reactors had fallen to 25 per cent.

It is clear that this is not a true rate of infection, but is simply the number of reactors found in a particular age group. Some of those who reacted at the time of this study undoubtedly obtained their infection at an earlier age than is indicated. But it cannot fail to indicate in general the fact that infection is less in childhood, and is greater as age increases. It is equally clear that slightly but significantly in childhood, and definitely and markedly above the age of 30, the male is more often infected.

The reason generally given that the male has a greater morbidity and mortality from tuberculosis is that the male is much more prone to contagion because of his occupational hazard. Two observations here would cast doubt on this. One is that the boys and girls have no such background. The second is that those over 30 years of age, approximately an equal number of males and females (see Table 1), were all engaged in the same occupation, namely, factory work. It is probably true that infection is,



and it well may be that morbidity and mortality are, manifestations of a sex characteristic in the ages indicated.

For comparison with later data, Chart II (compiled from figures found in Table 1) gives the same data found in Chart I but arranged in 15 year intervals. This longer age span brings out even more strongly the predominance of male infectivity. It still does not answer the question that can be rightly asked—what part of those in one age group obtained their infection in a preceding age group? The use of the 15 year span reduces the incidence of those to whom this might have occurred, for the greater the span of years involved the fewer the number would be in which this is the situation.

It would be impossible to eliminate this difficulty except by a longitudinal study existing over a span of a life time and making tuberculin tests on each individual at stated intervals. Since the number of people involved would of necessity be large, and since people move from one community to another, and the length of the study would involve many different observers, this approach would be unrealistic.

In order further to show that the "cumulative incidence" is not a great factor in these figures, reference is made to a study made by the author* approximately 15 years ago. In it are given the number of reactors in 4,982 children (0-14 years) admitted to the same hospitals used in this study.

These children would in general represent the group that would appear in this present study in the 15-29 age group. In the years 1926-28, 14.8 per cent of all admissions had a positive reaction; in 1929-31, 9.4 per cent; in 1932-34, 5.6 per cent; showing a steady decline to the 1.3 per cent found in the present survey. If we take all the children, approximately 8 per cent in the earlier survey showed a reaction. This 8 per cent would be cumulative, and would be a part of the number showing a reaction in the 15-29 year group now. But referring to Table 1 it is seen that the number is 27 per cent. It is clear that the great majority of individuals in the 15-29 year group received their infection after childhood. In the earlier group 8 per cent are infected; in the latter, 27 per cent.

Since there have been no similar studies in this community, a similar comparison in other age groups is impossible.

It might also be added that if the infection seen to be present in the older age group, i.e., above 15 years of age, were a reflection of childhood infection, it would follow that now that childhood infection in this community has dropped to 1.3 per cent, there

*Paul W. Beaven: "Extent and Nature of the Decline of Tuberculous Infection in Children." *Am. Jour. Dis. Children*, 52:565-586, Sept. 1936.

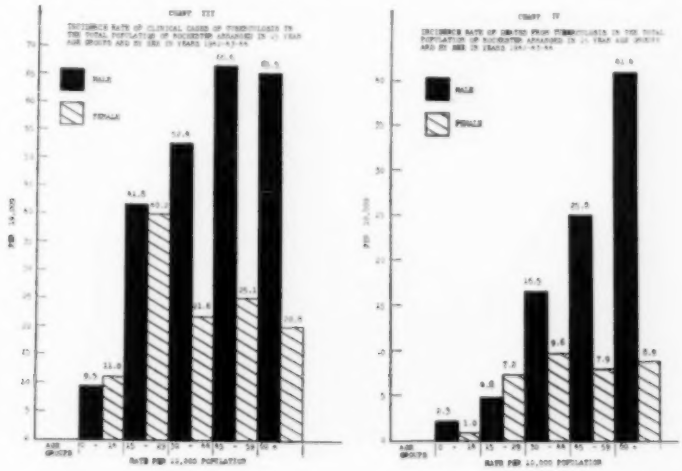
would ensue a similar precipitous drop in adult reactions to tuberculin.

It is more logical to assume that adult infection has in the great majority of cases occurred beyond the age of childhood.

Analysis of Clinical Cases of Tuberculosis Occurring in Rochester in 1942-43-44

We have just described the age and sex incidence of tuberculin reactors found in this community in 1942-43-44. The clinical cases reported in this city during the same years were then analyzed in the same fashion. It is fully realized that these could not be the cases resulting from these infections, but it would in a general way point out whether the incidence rate of clinical cases followed the incidence rate of infection. Reporting of clinical tuberculosis in Rochester is very good, for there has been for a number of years a Tuberculosis Registry in the Health Bureau, and every lead or contact is followed thoroughly. It is undoubtedly true that no other contagious disease is better reported. These figures are therefore close to the real incidence of clinical tuberculosis. It should be noted that the incidence rate is expressed not in percentages but number of cases per 10,000 population. The rates are obtained from Table 2, and graphically shown in Chart III.

At ages 0-14 cases are few and are about equally divided between male and female. In the next age group (15-29) the sex difference is negligible, but the total incidence of cases is four times as great. That is the highest incidence rate among the females. In the following age groups the incidence rate among the females drops to



half the rate recorded in the 15-29 year group. But what is clearly shown is that after the age of 30 in this study, the incidence rate of clinical tuberculosis in the male is even more marked than the incidence rate found in individuals who were infected only. The rise in total incidence rate of clinical infection found in Table 2 is due entirely to the increase in male clinical infection. A comparison with Chart II graphically shows that during the period described, in this community, the male is more often infected after 30 years of age, and Chart III shows that the male even more often exhibits clinical disease.

Analysis of Deaths from Tuberculosis Occurring in Rochester in 1942-43-44

A review of the deaths from tuberculosis during the years of the study was then made, noting the sex and age group of each patient. This is seen in Chart IV, the data for which appear in Table II.

These death reports are not absolutely accurate, but they are more than reasonably so. Iola Sanatorium is just outside the city limits but they keep a record of city deaths. These were the only ones used from that hospital. The Health Bureau records tuberculosis deaths occurring in the city. Some of these were in individuals whose residence was outside the city; these were excluded. There were a negligible number of deaths from tuberculosis among city residents that occurred outside the city or state. The data on these cases were not included since no official record of these is kept. Since tuberculosis is recorded as the primary cause of death even for patients who in reality die of other diseases, Dr. Bridge* and Mr. Lieberwurst** were asked if they felt this factor would be an important one. Both felt that the number so affected would be so small that it would have no statistical significance.

Chart IV shows that the incidence rate of deaths from tuberculosis in childhood is greater in the male. In the age group 15-29, it is greater in the female. After the age of 30 the male incidence rate is predominantly greater, increasing with each 15 year span. The female incidence rate does not increase at all, and the greater total incidence noted in Table 2 in each age group is due entirely to the mounting mortality found in the male. The observation made before, that the male after the age of 30 is more often infected and that he is still more prone to show clinical disease, can be supplemented by the observation that he is even more prone to succumb to the disease.

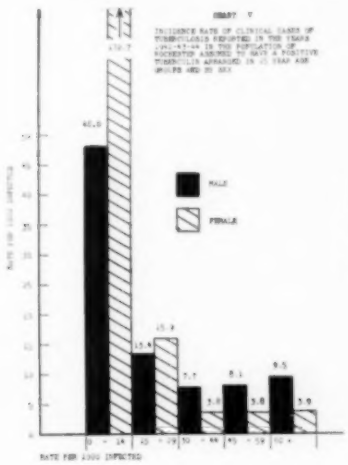
*Dr. Ezra Bridge, Superintendent of Iola Sanatorium.
**Mr. Henry Lieberwurst, Statistician for Rochester Health Bureau.

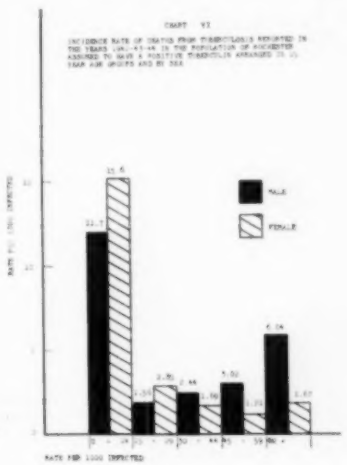
Clinical Tuberculosis Occurring in Those Infected

In order to obtain an incidence rate of the total infected population, the population of Rochester was separated into the 15 year age groups used throughout this study and arranged by sex. Such data were obtained from the 1940 U. S. Census. These data appear in Table 2. This is not entirely accurate, since the years involved here are 1942-43-44. The growth of the city area is slow, however, and statistically these figures would alter the observations little even if they were obtainable. An assumption is implicit that the incidence rates we have recorded reflect the incidence in the whole population. In the children undoubtedly the reported incidence is higher than the true incidence, since they were hospital cases. Among the factory workers the incidence rate would be much more accurate. None of the factories whose personnel is reported here had any screening test to determine the presence or absence of tuberculosis when they were employed. Other factories in the city do this, but we are not needed in such places, hence the survey included none of these.

If our assumption, then, is statistically warranted when we state that in an age group a certain number were infected, that can be translated in actual numbers, which is done in Table 2.

Chart V would seem to show that when infected the child is most prone to develop clinical disease, the female much more than the male. In like manner, the age group 15-29 when infected develops clinical tuberculosis much less than the child, but more than in future years, and again the female is more prone to have clinical disease following infection. But after the age of 30, once





infected, the male more than twice as often develops clinical disease. This is a corroboration of what was noticed in earlier charts, that the infected male after 30 develops clinical tuberculosis much more often than the female.

The important observation from this chart is that the young human animal (like the experimental animal) when infected with tuberculosis is more prone to develop clinical symptoms. The reason there is more clinical tuberculosis in older ages may well be due only to the fact that there is more primary infection in the older ages.

Deaths From Tuberculosis Occurring in Those Infected

If the number of individuals in Rochester assumed to have a tuberculin reaction at the time of this study are arranged in 15 year age groups, and also arranged by sex, and the number of deaths from tuberculosis during the same years are similarly classified, an impression can be gained concerning the mortality of those infected (See Chart VI).

It is seen here, as with clinical disease, the greatest mortality is in the first 14 years of life, and again the female is more often infected. Death does not follow infection any more in the next age group (15-29) than it does subsequently, but the female, as in the incidence rate of clinical disease, is more often the victim. After the age of 30, the infected male more often succumbs. This corroborates what was shown to be apparently the case by the earlier part of this analysis, that the infected male after 30 is much more prone to die. It is apparently true that when a child is infected it is more vulnerable to develop clinical disease, and the mortality likewise is greater. This also is what we would expect in experimental tuberculous infection.

Comment

It is admitted that a question could be raised concerning the validity of making a single study of children tested by the Mantoux method and adults tested by the Vollmer Patch test. The survey of the factories was begun with the Mantoux test, but an occasional bad reaction in an older individual was obtained, and the resistance to this method became so great that it had to be abandoned.

Before this review was undertaken, a comparison was made of the screening value of these two methods. There were 606 factory workers between the ages of 15-19 who were tested by the *Vollmer Method* (see Table 3), of which 9.9 per cent reacted. These workers were mostly in the 18-19 age group. During the years of our study the Health Bureau made *Mantoux Tests* on 7,848 juniors

and seniors in the high schools of the city. These boys and girls were a little younger than the factory group. Of these, 8.9 per cent reacted, about the proportion that would be expected if all had been tested in the same fashion. It was felt that this observation made during the study justified the belief that statistically there was no reason for not including all ages, though they were tested by different methods.

It is clear that the comparisons of infection with clinical disease and tuberculosis deaths made here are not perfect. This, as was stated, could not be, unless a longitudinal lifetime study were made. The facts as they have been gathered are shown here in one whole picture do seem to warrant a re-evaluation of the nature of the epidemiology and pathogenesis of this disease as it exists today, if Rochester is an example of other communities in this country. The trend outlined here is corroborated by observations made of what is going on at the present time by two local physicians well qualified to judge,* one the superintendent of the local County Tuberculosis Sanatorium, and the other the physician in charge of the tuberculosis work at the Eastman Kodak Company (a factory not included in this report). Both are agreed that the trend of new cases is in the older group, and chiefly in the male. Both are agreed that in these new cases they can rarely find any hint that the exposure was in early life. In many cases it is clearly evident that the infection came from a fairly recent contact. Both agree that the implications inherent in these statistics are a satisfactory explanation of what is happening in this community at this time.

SUMMARY

1) Infection with tuberculosis is relatively rare in children at the present time in this community.

2) Reaction to tuberculin after childhood increases precipitously, reaching its maximum at approximately the age of 50. After 50 years of age it declines, probably due to the fact that the skin of older people is not as sensitive.

3) This study shows that in this community the tuberculin reaction is slightly more prevalent in the male up to the age of 30; after this age the male is much more often infected.

4) This increased infectivity of the male does not seem to be due to environment, but probably represents a sex characteristic.

5) After the age of 30, not only is the infected male more prone to exhibit clinical tuberculosis than the female, but the disease is still more likely to be fatal.

6) Infection in the age group 0-14, more than at any other

*Dr. Ezra Bridge and Dr. Charles R. Allison.

time, results in clinical disease and death. Such consequences are less often noted in the 15-29 year group, and least after 30 years.

7) Since infection, clinical disease, and death from tuberculosis are all seen chiefly after childhood, the conclusion seems warranted that most cases of adult tuberculosis in this community result from infection beyond the age of childhood.

8) The reason that there is more clinical tuberculosis and death from tuberculosis in older ages may well be due to the fact that in the latter part of life there is more primary infection.

Acknowledgment is made to Miss Marie Goulett, Executive Secretary of the Rochester Tuberculosis and Health Association, for making available the statistics of the tests done on the factory workers. Acknowledgment is also made of the invaluable help of Mr. M. J. Wantman, Biostatistician, Director of the Bureau of Educational Statistics at the University of Rochester. Gratitude is expressed to Mr. G. J. Drolet, Statistician of the New York Tuberculosis and Health Association, for his encouragement and helpful suggestions made in the preparation of this manuscript.

RESUMEN

1) La infección tuberculosa es relativamente rara actualmente entre los niños de esta región.

2) La reacción a la tuberculina aumenta súbitamente después de la infancia, llegando su máximo aproximadamente a los 50 años. Después de 50 años de edad declina probablemente debido a que la piel de los viejos no es tan sensitiva.

3) Este estudio muestra que en esta comunidad la reacción tuberculínica positiva es ligeramente más frecuente en el hombre hasta la edad de 30 años. Después de esta edad el hombre es mucho más frecuentemente infectado.

4) Este aumento de la infección entre los hombres no parece deberse al medio sino probablemente representa una característica sexual.

5) Después de la edad de 30 años no solo el hombre es más propenso a enfermar que la mujer, sino que la enfermedad es más posiblemente fatal.

6) La infección en el grupo entario 0-14, más que en cualquier otro resulta en enfermedad clínica y muerte. Tales consecuencias son menos notables en el grupo 15-29 años y menos después de 30.

7) Puesto que la infección, enfermedad clínica y la muerte son observadas principalmente después de la infancia, parece justificado aseverar que la mayoría de los casos de infección tuberculosa en esta región resulta de una infección más allá de la infancia.

8) La razón por la que hay más tuberculosis clínica y muertes por tuberculosis en edades mayores puede bien ser porque en la parte avanzada de la vida hay más infección primaria.

Avoidable Delay in Diagnosing Bronchial Carcinoma

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Richmond, Virginia

Prior to 1925 bronchiogenic carcinoma was considered a rare disease. Since that time malignant lesions arising primarily in the tracheobronchial tree have not only increased in number but have been recognized more frequently, as methods for diagnosis have improved. Along with improvements in diagnosis, surgical techniques have been perfected to the point that removal of a lobe of a lung or the entire lung can now be accomplished with acceptable mortality and with much less distress to the patient than that following the average abdominal exploration.

The most disturbing feature now is that at the time of examination such a large percentage of the growths are so far advanced that surgical exploration is unjustifiable, and of those considered operable prior to exploration only a third are found to be resectable with reasonable chance of permanent eradication.

Whereas it is true that many of the tumors arising in the bronchi are highly malignant and a large percentage of cures can not be expected from surgery, yet earlier diagnosis than at present would undoubtedly result in greatly improved surgical results. Too often, delay in diagnosis is attributed to failure of the family physician or the general practitioner to recognize features characteristic of primary bronchial carcinoma. I am convinced, however, that the same criticism is applicable to the roentgenologist and the physician and surgeon specializing in thoracic diseases.

Entirely too much emphasis is placed on laboratory procedures and specialized examinations in diagnosing bronchial carcinoma, whereas the alert clinician should be able by ordinary methods of examination to detect the lesion with much greater accuracy than is possible with specialized studies. To be sure, examination should be made of the sputum for bacilli of tuberculosis, malignant cells and fungi, but presence or absence of any of these should not cause the clinician to waver in diagnosing carcinoma of the bronchus on the basis of well established clinical signs and symptoms.

Recently one of my patients who had signs and symptoms of

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bronchial carcinoma probably became inoperable because of a delay of six weeks caused by the finding of what appeared to be significant fungi in the sputum and the failure to find malignant cells in secretion from the bronchi or to obtain positive tissue at bronchoscopic investigation. Surgical exploration of the tumor, which should have been performed six weeks previously, revealed a hopelessly inoperable lesion.

In another patient operated on recently three examinations of the sputum elsewhere had been thought to reveal bacilli of tuberculosis. Delay in diagnosis in this case was not prolonged because clinical examination revealed evidence that seemed to indicate carcinoma, and on operation a removable tumor was encountered. There was no evidence of tuberculosis in the tissue that was removed.

Failure to establish microscopic evidence of tumor by study of tissue or secretions should not deter the surgeon from exploring surgically an indeterminate pulmonary lesion. I should also add that he must be convinced of the diagnosis of carcinoma prior to operation, as absolute diagnosis at the time of exploration is rarely possible unless the lesion is already beyond the stage of resectability.

At the present time I consider bronchoscopic examination more a method of determining operability rather than an essential procedure in diagnosis of bronchial carcinoma, and yet I have been able to obtain positive tissue in 75 per cent of the patients suspected of having primary bronchial malignancy. Study of secretions from the bronchi for cancer cells is untrustworthy, and unless there is clinical evidence of carcinoma, such study should not be accepted as a reliable indication of the presence of tumor. In the hands of the most experienced workers, falsely positive determinations occur entirely too frequently to make this means of diagnosis as dependable as conclusions reached by ordinary clinical methods.

Not infrequently delay in diagnosis results from failure of the patient to consult a physician until the disease is too far advanced for successful surgical treatment.

Although I am not in agreement with those who attribute increase in bronchial carcinoma to smoking, particularly cigarettes, I am convinced that diagnosis is often delayed because chronic cough that has resulted from smoking masks onset of irritation from intrabronchial neoplasm. Advertisements in reputable medical journals proclaim that certain brands of cigarettes do not cause irritation of the mucous membrane of the respiratory tract, but smokers are well aware that such assertions are not true.

Wheezing, which is one of the early significant symptoms and

signs of bronchial carcinoma, is often attributed to asthma, and a physician is not consulted.

Unfortunately loss of weight is not one of the early evidences of bronchial carcinoma. As a matter of fact, many patients with bronchial carcinoma appear in excellent general physical condition, and not infrequently there has even been a gain in weight of as much as 25 pounds in the preceding two or three months.

Another reason for failure to recognize malignant bronchial disease is a hopeful attitude on the part of the physician that an indeterminate lesion in the lung cannot be malignant because the patient is such a "nice fellow." Intimate social relationships often make diagnosis of malignancy distasteful to the patient and the physician.

A frequent early manifestation of bronchial tumor is partial obstruction with infection, associated with fever, leukocytosis, and expectoration of purulent material which may or may not be discolored with blood. Penicillin reduces or eliminates the infection, the patient improves, and diagnosis may thereby be delayed for several months.

The diagnosis of unresolved or atypical pneumonia is one of the most common causes for delay in identifying bronchial tumor and should not be made until every diagnostic procedure has been employed to attempt to detect carcinoma and the patient has completely recovered from his illness.

During the past 10 years in only one of my patients who was operated on for suspected bronchial carcinoma was a malignant tumor not found. In this patient an extensive tuberculoma involving the middle lobe of the right lung and the surrounding lymphatic nodes, with attachment and extension to the pericardium, was thought to be carcinoma until microscopic examination of the tissue revealed tuberculous infection.

In numerous other cases malignant disease was found at operation when the lesion was thought to be benign prior to exploration, and in three patients malignant degeneration was encountered in the wall of infected cysts.

No doubt many patients have been denied possible beneficial results from surgery by the assumption that since the diagnosis of carcinoma could not be proved, indefinite pulmonary lesions must be inflammatory or benign in character. I believe that when in doubt as to the diagnosis of a chronic pulmonary lesion, operation should be recommended because carcinoma will be found in more than 90 per cent of such patients.

If unnecessary delay in diagnosing bronchial carcinoma is to be avoided, what should be the attitude of the general practitioner and the physician and surgeon specializing in thoracic diseases

regarding chronic pulmonary lesions of uncertain etiology? I should like to make the following suggestions.

Chronic persistent cough may result from irritation due to smoking, but persons who smoke should have careful examination of the lungs at fairly frequent intervals if malignant disease of the bronchi is to be detected early enough for surgical resection. A chronic cough that becomes more persistent, and especially if it is associated with wheezing or expectoration of streaks of blood, demands careful study.

Roentgenoscopic demonstration of a single mass in the parenchyma of the lung even without pulmonary signs or symptoms, particularly if there is evidence of osteo-arthropathy, is sufficient to justify surgery and removal of the affected lobe of the lung or the entire lung, depending upon the findings at operation.

Any infiltrative, unilateral lesion in the hilar area of the lung, associated with diminished or absent breath sounds over the corresponding area of the lung without appreciable change in percussion note, is sufficient for diagnosis of bronchial carcinoma. Other studies, such as examination of the sputum for organisms and malignant cells, as well as bronchoscopic investigation, should rarely be omitted in examination of a patient suspected of having bronchial malignant disease, but diagnosis can and should be made with extreme accuracy and without disastrous delay by also employing well known clinical methods of study.

Finally, I quote from Strumpell's textbook of medicine, which was first published in 1886, and in which he writes in reference to primary malignant disease of the bronchus:

"In the cases observed by the author a striking diminution of the respiratory murmur over localized areas, despite normal pulmonary resonance, was often the first decided change in the physical signs."

SUMMARY

1) Earlier diagnosis in primary bronchial malignant disease is necessary if operation is to provide increasingly satisfactory results.

2) Too frequently delay is occasioned by insisting on microscopic evidence of tumor and not accepting well known clinical findings that are at least equally trustworthy in diagnosis.

3) Chronic persistent cough frequently results from irritation due to smoking but persons who smoke should have careful examination of the lungs at fairly frequent intervals if malignant disease of the bronchi is to be detected early enough for surgical resection.

4) A chronic cough that becomes more persistent, and especially

if it is associated with wheezing or expectoration of streaks of blood, demands careful study.

5) Roentgenoscopic demonstration of a single mass in the parenchyma of the lung even without pulmonary signs or symptoms, particularly if there is evidence of osteo-arthropathy, is sufficient to justify surgery and removal of the affected lobe of the lung or the entire lung, depending upon the findings at operation.

6) Any infiltrative, unilateral lesion in the hilar area of the lung, associated with diminished or absent breath sounds over the corresponding area of the lung without appreciable change in percussion note, is sufficient for diagnosis of bronchial carcinoma.

RESUMEN

1) Para obtener un resultado satisfactorio con la operación, en las enfermedades malignas de los bronquios, es necesario el diagnóstico precoz.

2) Con mucha frecuencia el tratamiento es demorado, debido a la insistencia en obtener una evidencia microscópica del tumor, y porque no se aceptan conocidas evidencias clínicas, las cuales son tan seguras en el diagnóstico.

3) Frecuentemente, la tos crónica y persistente es debida a la irritación producida por el cigarrilo. Los fumadores deben ser sometidos a cuidadosos y frecuentes exámenes, si se desea hacer un diagnóstico precoz y extirpación quirúrgica, de las enfermedades malignas de los bronquios.

4) Una tos crónica y persistente, y especialmente cuando se asocia con cornaje y esputos hemoitoicos, exije un estudio serio.

5) La demostración radiológica, de una tumoración solitaria en el parénquima pulmonar, sin síntomas, y particularmente si está asociada con alguna osteo-artropatía, es suficiente como para justificar una exploración quirúrgica y la extirpación de un lóbulo o de todo el pulmón, de acuerdo a la indicación, en la mesa de operaciones.

6) Una lesion infiltrativa, unilateral en la región hilear del pulmón, asociada con disminución o ausencia del murmullo vesicular en la región correspondiente, aun sin cambios apreciables en la percusión es suficiente para hacer un diagnóstico de carcinoma bronquial.

REFERENCE

1 Strümpell, Adolph v.: "Textbook of Medicine," Ed. 4, New York, *Appleton and Co.*, 1914, Vol. I, p. 338.

Re-Expansion of the Artificial Pneumothorax Lung

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This study has for its purpose the analysis of the re-expansion period in 142 pneumothoraces in which the lungs re-expanded at the Western Hospital Chest Clinic in the years 1943 to 1945, from the point of view only of the immediate results obtained.

Of the total number, 91 (64 per cent) were re-expanded entirely optionally, on the decision of the operator that refills might safely be stopped. The remaining 51 were re-expanded for various other compelling reasons which are itemized in Table 1.

In the series of 180 cases reported by Aguilar and Sirlin[1] only 31 per cent could be collapsed as long as considered necessary. However the present series covers only the post-sanatorium period.

TABLE 1

Reasons for Discontinuing Pneumothorax

Entirely optional	91 cases (64 per cent)
Adhesive pleuritis	23
Contralateral spread	7
Pleural effusion	5
Lost by technical error	3
Nervousness of patient	3
Failure of patient to attend	3
Refill reactions	2
Change to other collapse method	2
Sudden re-expansion	1
Pneumothorax ineffective	1
Death (nontuberculous)	1

Some comments on parts of this table seem of interest.

Adhesive Pleuritis: Twenty-three of the 142 cases were discontinued for this reason. This is 16 per cent. All the 142 cases had completed their sanatorium treatment and all but two had had pneumothorax for over two years. Nearly all of them were close to the time when pneumothorax would have been discontinued optionally. In no case in this group was it thought necessary to use any other collapse method following the termination of pneumothorax. So it seems unlikely that this complication was of any importance in this series.

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Technical Error: Of three cases classed as lost by technical error, the records in two suggest that one or more refills had been given into the lung resulting in loss of pneumothorax. In another case small refills and a tiny pneumothorax cavity appeared to be the reason for loss. In all three it is probable pneumothorax could have been re-induced but it was felt that the treatment had been given long enough.

Rapid Re-expansion: One case appeared to re-expand quickly. This patient had a complete atelectasis of lung beneath the pneumothorax in 1943. This had re-expanded to the desired degree three months later. In 1944 the lung re-expanded completely over a period of four to six weeks in spite of refills of 250 to 325 cc. of air every two weeks. A bronchial valvular inflation-re-expansion seems the most likely explanation.

Ninety-one Cases Optionally Re-expanded: The balance of this study is concerned with 91 cases optionally re-expanded. The average duration of pneumothorax in these cases optionally re-expanded was 64.5 months, ranging in duration from 21 to 111 months and distributed as in Table 2.

TABLE 2

Duration of Optionally Discontinued Pneumothorax

Months	No. of Pneumothoraces
21-24	3
25-36	1
37-48	16
49-60	21
61-72	21
73-111	29
TOTAL	91

It will be noted that more than half of these cases had their pneumothorax for over five years. Nearly all were of the economic class that lives at a bare subsistence level and this may justify such a long duration of pneumothorax treatment. Long-term results, however, are not being considered in this study of the re-expansion period.

Immediate Results: Full re-expansion, without appreciable mediastinal shift or radiological evidence of definite pleural thickening or effusion, was secured in 40 of the 91 cases, or 44 per cent of all optionally re-expanded. This compares closely with the results recorded by Morris[2] who reported a total of 39.7 per cent with "practical return to normal" or "slight fibrosis or little visceral displacement."

It is apparent that only about 40 per cent of pneumothorax cases optionally re-expanded will have a radiological appearance approaching the normal on eventual re-expansion.

Factors Affecting Result of Re-expansion: It is well known that full expansion is more likely to be obtained in disease of little extent than in the presence of advanced disease. However it was felt that other factors might also be important and an attempt was made to assess the following in relation to the result of re-expansion: Duration of pneumothorax treatment, duration of re-expansion period, presence of any detectable pleural effusion prior to re-expansion period, method of management of re-expansion period.

Duration of Pneumothorax Related to Result: The tendency is to keep extensively-diseased lungs collapsed longer than when little disease is present. It is therefore probably the extent of disease which controls the result in most of these cases. However Table 3 shows the result of re-expansion related to the duration of pneumothorax treatment.

TABLE 3

Full Re-expansion Related to Duration of Pneumothorax

Duration of pneumothorax	No. of pneumothorax cases	Full expansion	X-ray evidence effusion or pleural thickening	Shift of mediastinum	Per cent full expansion
48 mos. and under	20	13	6	2	65
49-60 mos.	21	13	6	3	62
Over 60 mos.	50	14	27	15	28

It does not seem possible to the writers to reach a definite conclusion from these figures on the relationship of duration of pneumothorax to expansion of the lung, but one cannot but gain the impression that long duration of pneumothorax somewhat reduces the chances of full re-expansion.

Prior Pleural Effusion Related to Expansion: The figures in Table 4 suggest that it is desirable to prevent the formation of

TABLE 4

Pleural Effusion Prior to Re-expansion Related to Result

Amount of effusion	No. of pneumothorax cases	Full expansion	X-ray evidence effusion or pleural thickening	Shift of mediastinum	Per cent full expansion
None ever found	42	22	16	5	52
Transient trace or more	48	17	24	9	35
No information	1				

effusion if this be possible. The only way of preventing tuberculous effusions once pneumothorax is induced, is the severing of adhesions. This procedure has been shown to prevent more serious effusions than it may cause.

It seems certain that where high negative pressures are permitted, pleural effusion may develop as a transudate into the pleural cavity. It is to be remembered that when the lung has little or no tendency to re-expand, high negative pressures may develop in the pleural cavity as air is absorbed. In this situation intervals should not exceed two weeks, and even weekly refills may be needed in spite of, indeed because of, the fact that the lung does not tend to re-expand. And highly positive final pressures may be used as a means of lengthening the interval slightly. Such high pressures are justified by the fact that these lungs are not expandable.

For the same reason, namely to prevent the development of highly negative pressures, pneumothorax refills should usually not be stopped abruptly, but should be tapered off.

Method of Re-expansion Related to Result: In a public clinic where the patient is apt not to be treated by the same operator at every visit, and where fluoroscopy is done by someone other than the operator, and when even the decision to discontinue pneumothorax is not made by the operator, there is difficulty in obtaining satisfactory management of re-expansion by the tapering-off method. In our clinic refills have usually been discontinued abruptly. In an effort to correct these conditions, when in consultation a decision is made to re-expand by tapering off, a heavy *blue* line is ruled as a margin from top to bottom of the pages, to be seen by fluoroscopist as well as operator.

Table 5 shows the results of re-expansion related to the manner of discontinuing refills.

If high negative pressure is an important cause of pleural reac-

TABLE 5

Method of Re-expansion Related to Result

Method of re-expansion	No. of pneumothorax cases	Full expansion	X-ray evidence effusion or pleural thickening	Shift of mediastinum	Per cent full expansion
Pneumothorax stopped abruptly	78	31	37	17	39
Pneumothorax stopped gradually	11	9	2	0	82
No information	2				

tion one would expect to observe more pleural reaction in the x-ray findings of cases slow to re-expand than in cases capable of being re-expanded rapidly. Table 6 shows this expectation to be a fact.

TABLE 6

Time Required for Re-expansion Related to Pleural Reaction

Pneumothorax re-expanding	Number of pneumothoraces	X-ray evidence of effusion or pleural thickening on re-expansion	Per cent pleural reaction
In 1 to 3 months	12	3	25
In 4 to 6 months	36	11	31
In over 6 months	34	18	53

SUMMARY

1) A considerable number of pneumothoraces, in this series, 36 per cent were discontinued because of the occurrence of various complications, and before the operator would otherwise choose to allow re-expansion.

2) A rather high percentage of pneumothoraces optionally discontinued, ended with evidence of pleural thickening or mediastinal shift.

3) In this series only 44 per cent re-expanded fully without x-ray evidence of pleural thickening or mediastinal shift.

4) Although the functional impairment in the cases in this series with pleural thickening or mediastinal shift was probably not severe it seems desirable to minimize the occurrence of such changes if possible.

5) Some evidence is presented that the high negative pressures of the re-expansion period are responsible for the occurrence of pleural thickening and for mediastinal shift.

6) It is suggested that re-expansion should be gradual, i.e. that pneumothorax refills should not be stopped suddenly but should be tapered off.

RESUMEN

1) Un número considerable de neumotorax en esta serie, 36 por ciento, fueron interrumpidos, debido a varias complicaciones; ante que el médico tratante, resolviera dejar expandir el pulmón.

2) En un por ciento alto de neumotorax, que se han interrumpido voluntariamente se observa espesamiento pleural y desplazamiento del mediastino.

3) En esta serie, solamente 44 por ciento, se reexpandieron, sin

evidencia radiológica de espesamiento pleural y desplazamiento del mediastino.

4) Aunque los transtornos funcionales en los casos de esta serie, con espesamiento pleural y desplazamiento del mediastino, no eran severos, serie conveniente reducir la incidencia de ellos en lo posible.

5) Se presenta alguna evidencia en favor de que, la alta presión negativa en el periodo de expansión, es responsable por la ocurrencia del espesamiento pleural y desplazamiento del mediastino.

6) Se sugiere que la reexpansión debe ser gradual, por ejemplo, que los neumotorax no deben interrumpirse de golpe, sinó, en forma gradual.

REFERENCES

1 Aguilar, O. P. and Sirlin, G.: *Arch. Argentin. de Tisiol.*, 18:54, 1942.
2 Morriss, W. H.: *Am. Rev. Tuberc.*, 46:628, 1942.

Streptomycin Blood Levels Following Inhalation of Steam Generated Aerosols*

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Streptomycin aerosol has been found useful in the treatment of respiratory infections such as bronchitis, bronchiectasis, infective asthma, and related conditions where the infecting organisms were of the gram negative group (penicillin-resistant and streptomycin-sensitive). Olsen[1] advocated combined penicillin and streptomycin aerosol therapy in the treatment of bronchiectasis where the bacterial flora is usually of the mixed type. Hinshaw and associates[2] advised streptomycin aerosol for tuberculous ulcers in the respiratory tract along with parenteral therapy. It was the opinion of Nichols and Herrell[3] that streptomycin aerosol is poorly absorbed through the lung, thereby limiting it as a method in the treatment of pulmonary tuberculosis. Emphasis, therefore, has been placed on the local topical action of the streptomycin given in aerosol form.

Earlier studies by the senior author[4] with steam-generated aerosols of penicillin revealed that high and prolonged blood levels (up to 6 hours) are readily obtained by creating more stable aerosols, and by confining and conserving the aerosols by means of a closed chamber, a tent or a breathing box. It was, therefore, decided to investigate streptomycin as an aerosol, utilizing these methods.

Methods and Materials

The combined steam generator and aerosolizer and the methods of its use, have been described in detail elsewhere.[4,5]

Patients were selected who had no apparent pulmonary infections, and whose vital capacity was not impaired, since it was shown earlier by one of us (S.J.P.) that deliberate reduction of the vital capacity markedly impaired the inhalation and absorption of penicillin aerosol.[6] These patients were treated with varying doses of streptomycin** by the open method, under a tent or with

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Streptomycin estimations were performed by Miss Mary Bell, B.S., and Miss Rita Kohler, B.S.

**Streptomycin calcium chloride complex was given in generous supply for this study by Dr. Hugh Gibson of Merck & Co., Rahway, New Jersey.

the aid of a breathing box—a device into which the aerosol is blown and from which the patient inhales by means of tubing and a mask. This device not only serves to confine and conserve the aerosol but also acts as a baffle, precipitating the larger aerosol particles which are condensed together with the steam and the vehicle, propylene glycol. The latter was chosen as the vehicle for the production of aerosols because it definitely stabilizes the aerosol—it lasts longer and is, therefore, used more advantageously. Unlike penicillin, streptomycin (calcium complex) is not soluble in propylene glycol and produces, instead, an insoluble gummy mass. The streptomycin was, therefore, dissolved first in 2 or 3 cc. of water, the desired amount of propylene glycol (20 cc.) was then added, producing a clear solution of streptomycin in propylene glycol.

Streptomycin determinations in serum were made by a serial dilution method, utilizing a sensitive strain of staphylococcus aureus (SM). Samples were taken prior to treatment, to eliminate the possibility of spontaneous antibacterial activity frequently seen in normal sera. None were noted in these studies. Blood samples were taken thereafter at intervals of one half, one, two, four and six hours following the onset of treatment, which usually lasted about 15 minutes with the open and breathing box methods. In utilizing the tent the patient was confined for one hour, even though gross evidence of the aerosol may have disappeared in one half hour.

Results

Twenty series of determinations, as recorded in Table 1, definitely show that streptomycin in aerosol form is readily absorbed from the lungs into the blood stream. With the open inhalation method in which much of the aerosol is lost by dissipation, streptomycin may be detected for two hours following the onset of inhalations utilizing 0.5 to 1 gm. of the drug. The streptomycin blood levels ranged from 1.56 to 12.48 units or micrograms/cc. of plasma. Somewhat higher blood levels were obtained with the open method when propylene glycol was used as the vehicle instead of water. This was not due to the antibacterial action of propylene glycol and serum against the test organisms as shown below.[7]

In utilizing the tent method, it is noted that higher blood levels of streptomycin were obtained where propylene glycol was the vehicle, and where the aerosol had greater stability and lasted longer than the aqueous aerosol (Table 1) but here, the propylene glycol may have been a factor. The highest levels of streptomycin, and of longest duration, were obtained, however, in cases 14

TABLE 1: Streptomycin Blood Levels—Following Aerosol Administration

Method of Aerosolization	Amount of Streptomycin	Diluent	Case No.	Micromilligrams of Streptomycin/cc. Serum				
				0 hr.	1/2 hr.	1 hr.	2 hrs.	4 hrs.	6 hrs.
Open Inhalation	1 Gm.	H2O - 20 cc.	1	0		6.24	6.24	3.12	1.56
		Propylene Glycol - 20 cc.	2	0	0	3.12	3.12	0	0
		Propylene Glycol - 20 cc.	3	0	1.56	3.12	3.12	0	0
	.5 Gm.	H2O - 20 cc.	4	0	4.68	4.68	4.68	0	0
		H2O - 20 cc.	5	0	3.12	3.12	3.12	0	0
		Propylene Glycol - 20 cc.	6	0	6.24	12.48	12.48	0	0
		Propylene Glycol - 20 cc.	7	0		12.48	12.48	0	0
	.25 Gm.	H2O - 20 cc.	8	0	1.56	1.56	1.56	0	0
		H2O - 20 cc.	9	0	1.56	1.56	0	0	0
Tent Method	1 Gm.	H2O - 20 cc.	10	0	1.56	1.56	1.56	0	0
			11	0	1.56	1.56	0	0	0
		Propylene Glycol - 20 cc.	12	0	1.56	3.12	1.56	1.56	0
			13	0	1.56	3.12	3.12	1.56	0
Breathing Box	1 Gm.	Propylene Glycol - 20 cc.	14	0	1.56	6.24	6.24	3.12	1.56
			15	0	1.56	6.24	6.24	6.24	3.12
			16	0	6.24	6.24	24.96	6.24	6.24
	.5 Gm.	Propylene Glycol - 20 cc.	17	0	1.56	1.56	6.24	3.12	0
			18	0	3.12	6.24	6.24	6.24	0
			19	0	6.24	24.96	6.24	3.12	1.56
			20	0	6.24	6.24	6.24	3.12	1.56
	0 Gm.	Propylene Glycol - 20 cc.	21	0	1.56	1.56	1.56	1.56	1.56
			22	0	3.12	3.12	3.12	3.12	3.12
			23	0	1.56	1.56	1.56	1.56	1.56

TABLE 2: Blood Levels of Streptomycin Following Parenteral Administration

Method of Administration	Amount of Streptomycin	Diluent	Case No.	Micromilligrams of Streptomycin / cc. Serum				
				0 hr.	1/2 hr.	1 hr.	2 hrs.	4 hrs.	6 hrs.
Intramuscular	1 Gm.	H2O	1	0	49.92	49.92	12.48	3.12	3.12
		2 cc.	2	0	49.92	49.92	12.48	3.12	3.12
	.5 Gm.	H2O	3	0	3.12	6.24	6.24	12.48	6.24
		2 cc.	4	0	12.48	12.48	24.96	3.12	3.12
	.25 Gm.	H2O	5	0	1.56	6.24	6.24	3.12	1.56
		2 cc.	6	0	1.56	6.24	6.24	6.24	3.12
Intravenous	.5 Gm.	H2O	7	0	199.68	12.48	6.24	3.12	3.12
		10 cc.	8	0	99.84	24.96	12.48	6.24	6.24
	.25 Gm.	H2O	9	0	1.56	1.56	0	0	0
		10 cc.	10	0	1.56	3.12	6.24	3.12	1.56

through 20, where the breathing box method was employed. This paralleled our earlier observations with penicillin aerosol.

The streptomycin blood levels obtained by the aerosol method do not reach those obtained when the drug is administered parenterally. This is shown in Table 2 in which are recorded 10 series of determinations, utilizing streptomycin in doses ranging from 0.25 to 1 gm. It is noteworthy that six-hour blood levels of streptomycin were obtained in most of these determinations, whether given intravenously or intramuscularly, in sharp contrast to the two to three hour blood levels reported in penicillin studies.[8]

In utilizing the breathing box, a condensate is obtained which in itself is still potent. Studies were, therefore, undertaken (Table 3) in which the condensates were collected and assayed in five experiments. These varied from 27 to 72 cc. and ranged in potency from 83,769 to 227,635.2 units. The difference in amount of condensate is readily explained by the duration of treatment. The longer the treatment the more steam is generated and condensed. As for the total number of units of "streptomycin" determined in these condensates, it must be recalled that in part this is due to the propylene glycol in the condensate, as shown below.

Control Studies

Control studies were undertaken to evaluate the effect of propylene glycol-serum mixture on the test organism, and these revealed that by open inhalation not enough propylene glycol is absorbed to affect the results. With the use of the breathing box, however, sufficient propylene glycol is absorbed to become a factor in the evaluation of the "streptomycin units" obtained in these studies. Thus, in cases 21 and 23 (Table 1), values of 1.56 "units," and in case 22, 3.12 "units" were demonstrated in the blood from the inhalation of propylene glycol alone through the breathing box. A correction factor of at least 2.08 "units" (the average of the three determinations) would have to be ap-

TABLE 3: Studies with Condensates Obtained from Breathing Box

Exp. No.	Amt. Strep. Aerosolized	Diluent	Condensate	Units/cc. of Strep.	Total Units
1	1 Gm. (1,000,000 Units)	Propylene Glycol - 20 cc.	72 cc.	1996.8	83,769
2	"	"	57 cc.	3993.6	227,635
3	"	"	27 cc.	4992.0	134,784
4	.5 Gm.	"	30 cc.	4992.0	149,760
5	.5 Gm.	"	30 cc.	4992.0	149,760

plied to all the values obtained with the "breathing box" method to obtain the true value of streptomycin present in the blood.

In view of the propylene glycol effects noted above, a limited study was undertaken, utilizing a test organism not affected by propylene glycol-serum mixture. Accordingly, the method of streptomycin assay utilizing B. circulans was employed[9] and the results are recorded in Table IV.* Five normal subjects were treated with an aerosol of 1 gm. streptomycin in 20 cc. of propylene glycol, administered through the breathing box for periods ranging from 5 to 12 minutes.

From these studies it may be concluded that propylene glycol does not interfere with the bio-assay of streptomycin, where B. circulans is used as the test organism, and that streptomycin was demonstrable in the blood in the five subjects tested by the fourth hour following treatment with streptomycin aerosol through the breathing box. The comparatively low blood values, and the delay in their appearance in these instances, are probably due to the shorter time of treatment.

Reaerosolization

The condensate need not be discarded since it still has therapeutic value, and where expensive drugs are involved its possible utilization is important. An experiment was, therefore, undertaken (Fig. 1) in which patient A was treated with 1 gm. of streptomycin through the breathing box, and blood determinations showed a

*We are grateful to Dr. Norman Molomut of the Biological Laboratories, Brooklyn, New York, for these determinations.

TABLE 4: Streptomycin Determinations Utilizing *B. Circulans as the Test Organism*

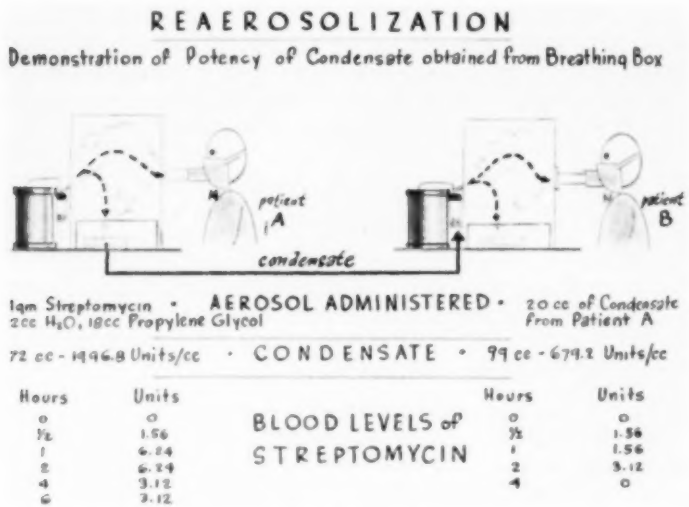
Subject: Blood Samples:* calculated streptomycin activity in mcg. ml.

	Control	1	2	3
J. P.	0	0	0	2.5
J.F.	0	0	0	1.2
I.J.	0	0	0	1.2
R.F.	0	0	1.2	2.5
N.M.	0	0	0	1.2
Standard streptomycin	10			

*Blood samples: Control — prior to treatment
No. 1 — 1 hour after propylene glycol
No. 2 — 2 hours after propylene glycol
1 hour after streptomycin in propylene glycol
No. 3 — 4 hours after streptomycin in propylene glycol

six-hour level of streptomycin. At the end of treatment 72 cc. of condensate was obtained which showed a potency equivalent to 1996.8 streptomyicn units (micrograms)/cc.—20 cc. of this condensate was then reaerosolized and administered through the breathing box to patient B, which resulted in a two-hour blood level of streptomycin, and a second condensate of 99 cc. which was still potent to the extent of 679.2 units/cc.

It would be desirable in clinical practice, therefore, to reaerosolize the condensate, or to use the condensate as a diluent where feasible, for the next treatment.



CONCLUSIONS

Streptomycin in aerosol form as produced by a combined steam generator and aerosolizer is readily absorbed through the lung into the blood stream. Administered in this fashion its action would, therefore, be twofold in the treatment of respiratory infections with streptomycin—topically and by systemic action following absorption.

With the use of the breathing box, and with propylene glycol as a vehicle, serum levels of streptomycin of six hours' duration are readily obtained.

CONCLUSIONES

La streptomicina en forma de aerosol, como es la producida por el vaporizador y nevuliador, es absorvida en la sangre, en forma satisfactoria, a travez del pulmón.

Administrada en esta forma, se obtiene un doble efecto en el tratamiento de las infecciones respiratorias, local, y después de absorvido, general.

Se obtienen concentraciones de streptomicina en la sangre, por espacio de seis horas, con la ayuda de la caja respiratoria y el glicol propílico, como vehiculo.

REFERENCES

1 Olsen, A. M.: "The Nonsurgical Management of Bronchiectasis," *Med. Clin. No. Am.*, 30:863, 1946.

2 Hinshaw, H. C., Pyle, M. M. and Feldman, W.: "Streptomycin in Tuberculosis," *Am. J. Med.*, 2:429, 1947.

3 Nichols, D. R. and Herrell, W. E.: "Streptomycin: Its Clinical Uses and Limitations," *J.A.M.A.*, 132:200, 1946.

4 Prigal, S. J., McGavack, T. H., Speer, F. D. and Harris, R.: "Blood Levels of Penicillin Obtained by Inhalation of Aerosols Produced by a Combined Steam Generator and Aerosolizer, with the Use of Propylene Glycol, Tents and a Breathing Box," *J.A.M.A.*, 132:932, 1947.

5 Prigal, S. J.: "The Production of Aerosols from Medicated Solutions: A Combined Steam Generator and Aerosolizer," *J.A.M.A.*, 131:398, 1946.

6 Prigal, S. J., Morganbesser, L. J. and McIntyre, F. P.: "Penicillin Aerosol in the Prevention and Treatment of Respiratory Infections in Allergic Patients," *J. Allergy*, 18:325, 1947.

7 Prigal, S. J., McGavack, T. H. and Bell, Mary: "The Effect of Propylene Glycol on the Antibiotic Activity of Human Serum," *Am. J. Med.*, 3:185, 1947.

8 Cooke, J. V. and Goldring, D.: "The Concentration of Penicillin in Various Body Fluids During Penicillin Therapy," *J.A.M.A.*, 127:80, 1945.

9 Price, C. W., Nielsen, J. K. and Welch, H.: "The Estimation of Streptomycin in Body Fluids," *Sci.*, 103:56, 1946.

Angiocardiopneumography*

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In October 1930, my collaborators and I made the first attempts at visualization of the arterial vessels of the lung. The first angiopneumography was done in February 1931. As the years passed, the findings resulting from the examinations made began to excite great interest; the method became more generalized; cardiologists adopted the procedure and applied it to the radiological study of the chambers of the heart. Angiocardiography has thus been established and it became a valuable method of investigation in the study of congenital cardiopathy, especially valuable today when any surgical intervention is considered with a view to correcting congenital abnormalities of the heart.

Angiopneumographic technic was perfected little by little. The method was simplified. Auricular catheterization became unnecessary. A simple injection of a contrast substance into the median basilic or median cephalic vein was sufficient to cast the shadow of the arterial tree of the lung on the film a few seconds later. This is Robb and Steinberg's technic.

I have been following closely all the modifications and improvements which, little by little, were introduced into the method which I had invented; I also tried, on my part, in the department which I direct in the teaching hospital of Santa Marta, to improve and simplify the technic already foreseen 18 years ago.

Auricular catheterization, originally indicated, was adopted because many patients cannot tolerate intravenous injection of sodium iodide in concentrated solution. At 30 per cent and over the solution was, in fact, extremely painful; and at that time other iodine containing salts which combined the harmlessness of the iodide with the quality of being painless, were unknown. Hence the technic then recommended.

Today everything has changed. With the appearance of certain products in the therapeutic arsenal, it has been possible to simplify the test and obtain a picture of the arterial design of the lungs by means of a simple intravenous injection. Based on long experience, I cannot but affirm that the angiopneumographic examinations carried out by intravenous injection given into the arm, never reach the perfection and clarity of the results obtained

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by catheterization. Chavez, Dorbecker and their collaborators have a similar impression, according to a recently published work. It is only reasonable that it should be so, for, in spite of the large dose of the product injected, its concentration in the plasma is inevitably reduced owing to the great quantity of blood which the two venae cavae pour continually into the right auricle. But this is not all. We have already had the opportunity to note that in the veins of the arm, the circulation never takes place as rapidly as we would wish; part of the product is temporarily retained along the venous wall, which means that the injected solution is not utilized in its entirety.

If the injection were made into the vena cava, the whole of the product would immediately pass into the auricle; catheterization would therefore become unnecessary. Puncture of that vessel is not, however, to be advised. What can be done then, to avoid, or at least to reduce as much as possible, the retention of the opaque substance along the course of the vein which it has to follow till it reaches the cavity of the auricle?

What naturally occurs to the mind of the investigator is to try to inject the contrast substance, not into the median cephalic, bu into a vein more proximal to the superior vena cava and which is easily accessible, as are the veins of the neck, the external jugular, for example.

In the course of the work done in 1931, we thought of using the external jugular, or the anterior jugular, for the introduction of the iodide. The pain caused by the highly concentrated solution was, however, the same as that observed in the arm veins, and that, consequently, prevented us from using this approach. It was then that we thought of using a small catheter, introduced into the jugular, and through which we might discharge the product into the proximity of the vena cava. We made several attempts with this object in view. The catheter which at first passed easily, encountered, however, after a short distance, an obstacle almost always impossible to overcome. If with slight pressure we tried to force it on, it only doubled back on itself and would advance no further. In one of the patients in whom this was observed we tried to discover the nature of the obstacle encountered. To this end, we introduced through the catheter a few cubic centimeters of the contrast substance and we proceeded, without stopping, to the radiographic inspection of the thorax; we observed then that the catheter had stopped at the level of the clavicle and that the opaque liquid had spread transversely at each side of the end of the catheter. This phenomenon was due to the fact that the external jugular almost always joins the brachio-cephalic trunk obliquely, at an internal acute angle, and for this reason it is im-

possible to continue in the direction of the vena cava. It was due to this difficulty that, in 1931, on reading an article of Forsmann, published in the Klinische Wochenschrift of November 5, 1929, we successfully attempted auricular catheterization from the median basilic or from the median cephalic vein, and we, at last, succeeded in obtaining the first angiopneumographic films in man.

The appearance of drugs of considerable opacity to x-rays and absolutely painless when injected into any venous segment, simplified, as might be expected, angiopneumographic technic. The introduction of the product into the external jugular was a natural sequence. We wanted to know whether the substance used would be partially retained in this vessel, such as occurred in the veins of the arm. Some previous experiments made concerning this showed us that the onward flow of the product was rapid and immediate. Any of the radiographs reproduced below are in reality demonstrations of this phenomenon (Figs. 5, 6, 7 and 8). The substance, as can be observed, rapidly passes to the auricle. There is in fact, as we have had opportunity to verify more than once, an actual aspiration of the product.

The blood stream in the vessels of the neck does not obey the same rules as the circulation of the blood in other venous trunks, as for example, in the extremities, which are so often punctured for therapeutic purposes. One always encounters great difficulty in aspirating a little blood from the cervical veins, and this can only be attributed to the marked negative pressure which exists

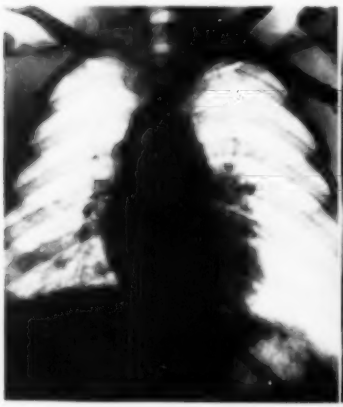

FIGURE 1

FIGURE 2

Fig. 1: The circulation is slow in the axillary and subclavian veins. For this reason, part of the opaque substance was temporarily retained therein.—*Fig. 2:* The opaque substance was not retained in the jugular vein. It passed rapidly towards the vena cava and auricle.

in them. In some laboratory experiments in animals, in the dog, for example, we have even been able to verify that, on exposure of the vena cava, the puncture of its superior extremity did not facilitate the aspiration of even a small quantity of blood, while the animal remained alive. The plunger of the syringe was, however, strongly repelled by the blood which entered as soon as the myocardial contractions ceased as a result of syncope. The volume of blood which was flowing from the whole peripheral venous system towards the right auricle, finding the chambers of the heart flooded, was forced to accumulate in the vessels; for this reason the negative pressure in the vena cava disappeared, and, owing to the accumulation of blood, an appreciable positive venous pressure developed.

In the veins of the arm, the absence of aspiration which occurs in the jugular vein is not only noted, but one even meets with a certain resistance to the rapid entrance of the product, a resistance which it is necessary to overcome, and which is visible in

FIGURE 3: Angiopneumogram obtained with an injection of 30 cc. of opaxil in the external jugular vein. We see the right auricle, the trunk of the pulmonary artery and its two branches. The ventricle is in systole.

the accentuated turgidity evident in the vein, on injecting the contrast medium under pressure (Fig. 1).

A comparison of the radiographs reproduced in Figures 2 and 1 is a clear demonstration of this phenomenon. In Figure 1, the venous trunk which comes from the arm is markedly turgid, its opacity being considerably more accentuated than that of the vena cava; in Figure 2 the product can still be seen leaving the needle, to pass down the jugular, but the vena cava is poorly defined; it is because the substance has passed rapidly into the chambers of the right side of the heart.

From the examination of these films and from what has already been said, a new angiopneumographic technic naturally follows. On the one hand, auricular catheteriation is no longer necessary, for the contrast media which have come to be used do not induce the slightest sign of pain on injection. On the other hand, the vein of choice for introducing the product should be the jugular, owing to its proximity to the vena cava. A simple injection of 20 to 30 cc. made into this vessel provides, in fact, complete visualization of the pulmonary artery. It is the technic which we have adopted lately, and which has produced the most brilliant

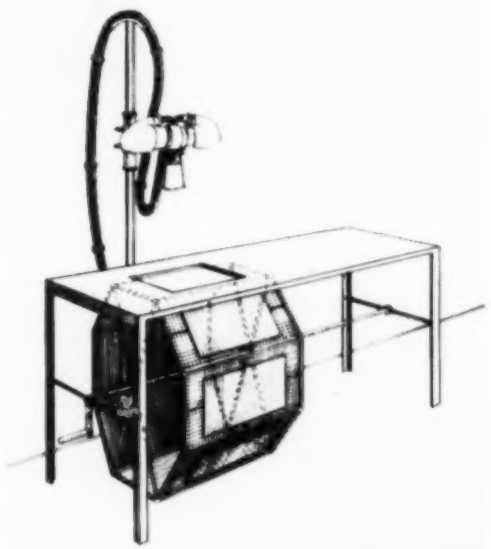

FIGURE 4: Plan of the rotary prismatic selector. The instant the cassettes reach the radiographic field, the ampule discharges automatically.

results. As a contrast medium we have used "Opaxil" produced by Schering's. It is a pyridine derivative with 51.5 per cent of iodine in close organic combination. It is put up as a 75 per cent solution in 20 cc. ampules. It does not provoke the slightest reaction, not even the fleeting headaches which are so often met with in the intravenous injection of "diodrast." After the angiopneumograph the patients do not feel the slightest indisposition, so that the investigation may be made in the city clinic, in the radiologist's own consulting rooms, like any other routine examination.

An ordinary 20-30 cc. syringe is sufficient, to which is fitted a needle with a diameter of 2 mm. As the skin of the neck is as a rule tough, and therefore always difficult to pierce, it is a good practice to inject previously at the site chosen for venipuncture half a cubic centimeter of novocaine without adrenalin. The patient will thus not feel the prick of the needle and will consequently remain calm and tranquil, without making the slightest reflex movement of defence.* Adopting this technic, we have lately obtained some angiopneumograms with almost as much detail as those we originally performed with auricular catheterization.

This new technic can also be applied to angiocardiographic examinations (Fig. 3); its simplicity and harmlessness enable it to be used as a routine measure in the study of all cardio-arterial anomalies. What is obviously required is suitable equipment to enable the various films to be taken in succession, to make possible the recording of the various phases of the cardio-arterial circulation.

When, instead of two or three successive radiographs, we can take four, six, or even eight every second, the problem may be considered to be completely solved, for the basis of radiological technic in any angiographic study is, in fact, the rapid changing of the films, in order to accompany the rapid rhythm of the circulatory phenomena. With comparative ease we can obtain three serial radiographs in less than eight seconds in order to catch the three principal phases of the lesser and greater circulations; this however, is not sufficient. A greater number of films is necessary for a complete study. We have used since January of this year a relatively simple apparatus which we had made for this purpose. With it we are able to make six or eight successive radiographic inspections with a variable time interval between each film. This apparatus consists essentially of a prism to the sides of which are fixed the cassettes charged with the respective films.

*There are patients whose jugular veins are narrow, and then it is not possible to introduce the needle into the lumen of the vein. In these cases the injection has to be made into one of the arm veins. It is possible that in such cases the visualization would not be so perfect, for reasons already indicated.

Placed under the examining table, it is made to rotate on beginning the injection of the contrast medium, and thus it presents successively in the radiographic field each of its cassettes. As each cassette reaches the required position, the ampule automatically

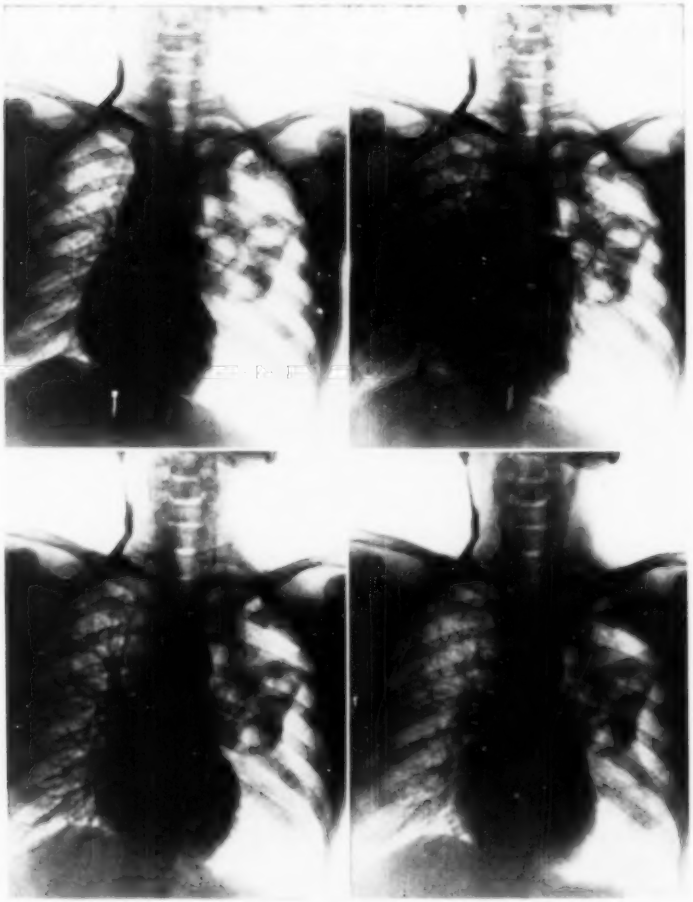

Figure 5, upper left: Successive films obtained with rotary selector after injection of 40 cc. of opaxil made in the external jugular vein. The opaque substance has reached the right ventricle, the trunk of the pulmonary artery and its two branches, particularly the right one. Left pneumothorax.—*Figure 6, upper right:* The opaque substance is in the capillary net-work. For that reason all the right pulmonary area is opacified. On the left side absence of the capillary circulation.—*Figure 7, lower left:* Disappearance of the capillary phase. Venous return circulation. Left ventricle opacified, left carotid artery visualized.—*Figure 8, lower right:* Disappearance of the contrasting substance from the lung. Visualization of the two carotid arteries.

discharges. The diagram, Figure 4, gives some idea of this rotary prismatic selector which we are now using with excellent results.*

*After writing this article, it came to my knowledge that Henry Taylor had published in the american journal "Radiology" (No. 1, Vol. 52 of January 1949) an article which describes an apparatus which is constructed entirely on the same lines as ours. From the date on which the article went to press, priority for the idea belongs to that author, for only at the session of the Lisbon Academy of Sciences, on January 20th this year, did I refer for the first time to the rotary prismatic selector which had been constructed shortly before by one of my collaborators.

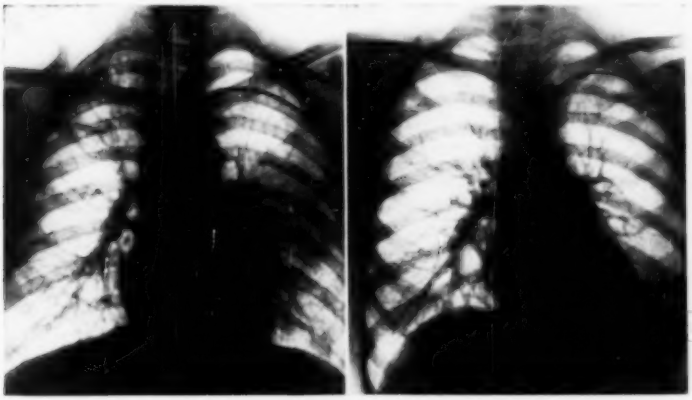

FIGURE 9 FIGURE 10

Fig. 9: Tuberculous lesions on the right. Abscess in the left lung. There is a very pronounced irrigation in the abscesses, contrary to what is observed in the tuberculous lesions.—*Fig. 10:* In the lung, which has collapsed under the action of pneumothorax, the angiopneumograms show a pronounced reduction of the pulmonary circulation. A small insuflation suffices to enable us to see this disturbance.

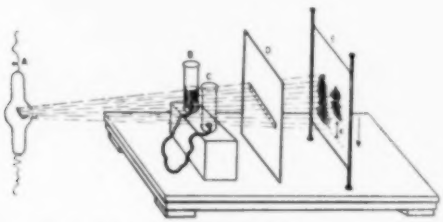

FIGURE 11: Plan of how the method functions: (A) ampule of the x-rays; (B) and (C) communicating vessels; (D) lead plate; (E) carriage with downward movement. If an opaque liquid be projected into the bottle (B), there appears a lighter band on the film. When this substance reaches bottle (C), another band appears on the film alongside the first. The distance between the beginning of the two bands allows us to calculate the time taken by the liquid to pass through the small tube, which connects the two bottles.

In Figures 5, 6 7 and 8 one can see reproduced some of the succession of films obtained during one of these examinations.

Angiopneumographic investigations enabled me to clarify the radiological appearances of the hilum, a study which constituted the material of a communication presented before the 10th Conference of the International Union Against Tuberculosis, which met in Lisbon in 1937. The essentially arterial constitution of the hilar shadows was then firmly established and many of the images till then interpreted as adenitis and periadenitis, were considered merely to be simple shadows of branches of the pulmonary artery. The fact is that the pulmonary artery is liable to give diverse hilar shadows. The existence of collapsed zones in the lung, the presence of effusion, deformities of the thorax, elevation of the diaphragm, etc., act, as might be supposed, on the pulmonary artery, making it take up various positions, naturally resulting in a great variety of images caused by it.

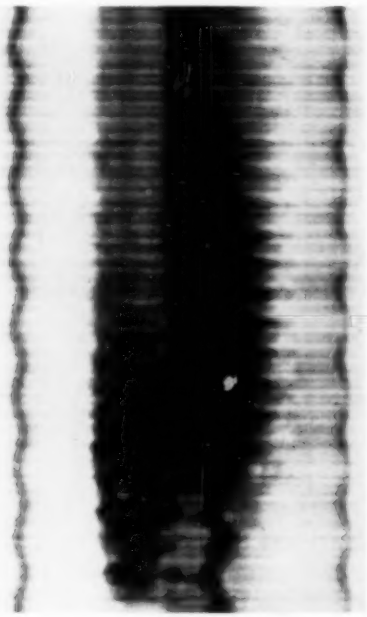

FIGURE 12: Record of the pulmonary circulation of the rabbit. If, in place of the two bottles, we place the thorax of a rabbit and if we inject into its jugular vein a contrasting liquid, the two bands which are registered allow us to calculate the time of the pulmonary circulation.

It was a comparison of simple radiographs and the respective angiograms, with the course of the vessels well defined, which enabled me to arrive at such conclusions with certainty and to show definitely that the majority of hilar shadows up to then interpreted as tracheobronchial adenopathy, were nothing more than simple shadows of the pulmonary artery.

The facts gathered from the angiopneumographic examinations are, therefore, not limited to explaining certain interpretations of radiographic images; as we shall see, they allow us also to form an idea of the vascular situation, in respect to the blood-supply.

The latter is often altered in the parenchymatous tissue. In regions of tuberculous lesions, for example, the angiopneumographic examination proved, as will be seen in some works published by us, that the pulmonary circulation is either absent or deficient. While, on the one hand, the normal parenchymatous tissue always shows a rich blood-supply, tuberculous foci, on the other hand, are bereft of any appreciable circulation.

Another fact verified by angiopneumograms, was that of the increased blood-supply at the region of lung abscesses, contrary to that which is observed in tuberculous processes. The arterial circulation noted in the angiopneumographic examinations is, therefore, sufficient to enable us to distinguish between the images of tuberculosis and those of common inflammatory nature. It is well to note that the differences in blood-supply between one and the other are related to the diversity of the anatomo-pathological processes involved. On the one hand, there are profound vascular alterations; on the other hand, the hyperemia which characterizes all acute inflammatory processes.

The angiopneumogram reproduced in Figure 9 is a demonstration of this fact. It is from a case of pulmonary tuberculosis in which the lesions on the right side were progressing to frank sclerosis, when, after being admitted to the hospital, an abscess developed in the middle lobe of the left lung. The temperature, which until then had been normal, rose sharply a few days after his admission, to 38-39 degrees C. A simple radiograph taken on this day revealed the existence of a diffuse shadow on the left side, which was naturally interpreted as a fresh tuberculous focus. The angiopneumogram, contrary to what was expected, showed in this zone a rich network of blood-vessels, in complete contrast to the absence of vascularization in the right upper lobe, the seat of the tuberculous process. Its rupture, which occurred a fortnight later, confirmed the angiopneumographic diagnosis.

Angiopneumography also allowed us to verify the great diminution of the pulmonary circulation in a lung collapsed by pneu-

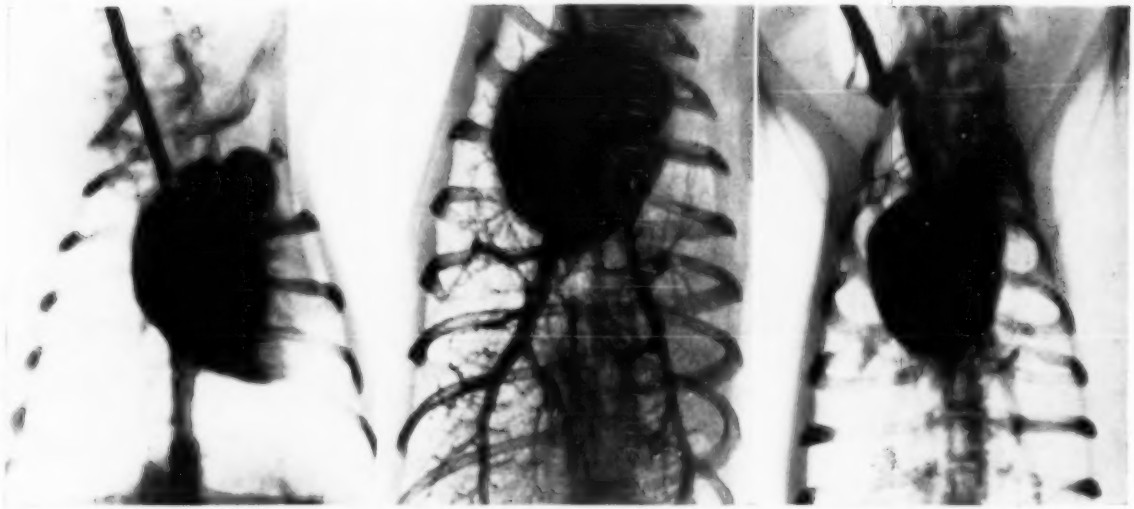

FIGURE 13 FIGURE 14 FIGURE 15

Fig. 13: Angiopneumogram of the rabbit. The change of opacity is first produced in the right cavities of the heart.—*Fig. 14:* Angiopneumogram of the rabbit. The opaque substance has entered the large arterial branches.—*Fig. 15:* Angiopneumogram of the rabbit. The opaque substance has reached the left cavities of the heart.

mothorax, as I was able to point out in an article published in the "Revue de la Tuberculose," in 1935.*

In all the angiopneumographic investigations carried out on tuberculous patients who have undergone treatment by pneumothorax, there is seen, without a single exception, the suppression, or at least the diminution, of the circulation in the collapsed lung (Figs. 5, 6, 7 and 8). The smallest introduction of air is enough to cause the circulation to undergo marked diminution. That is what is seen, for example, in one of the angiopneumograms reproduced in that article (Fig. 10). It was taken of a patient with pleurisy with effusion, from whom the fluid was withdrawn by puncture and substituted by a small amount of sterilized air.

This case in which there were no parenchymatous lesions, showed, therefore, that the marked diminution in the pulmonary circulation was a result of the collapse. When this is partial, with widespread superficial adhesions which prevent the collapse

*Lopo de Carvalho et Alberto de Carvalho: "Mode d'action du pneumothorax," *Revue de la Tuberculose*, No. 5, Mai, 1935.

FIGURE 16: Angiopneumogram of a man. Position I and II of the slit of the quimograph in order to show clearly the vessels which it intercepts; as position I shows, the slit cuts the vena cava, the aorta and the two apical arterial and venous branches of the upper lobes of the lung. In position II, the vena cava, the trunk of the pulmonary artery and its left branch as well as other vessels of lesser calibre, are intercepted.

of the subadjacent zones of the lung, the circulation is maintained in these zones but disappears in those in which the collapse is observed.

It is, therefore, understandable how collapse therapy gives rise to the rapid disappearance of symptoms of tuberculous intoxication, such as fever, sweating, anorexia, asthenia, etc. The relative or absolute suppression of the blood-supply does not, in fact, allow the toxins produced in the region of the bacillary foci to continue to be absorbed and disseminated through the organism.

The data provided by angiopneumographic technic do not stop here. Its use in other branches of medicine makes possible the establishment of original methods of investigation and a new orientation to methods of observation and analysis. I will refer to one of them: that of the exact determination of the circulation time in the lungs.

Various methods have been employed to find this out, all of them based on the introduction into one of the arm veins, of substances capable of provoking reactions which are easily observed as soon as they reach a given point. The time between the administration of the substance and the appearance of the reaction it produces, will obviously give the velocity of the blood flow between these two points.

One of the first substances employed with this end in view was ether, half a dozen drops diluted in ½ cc. of normal saline being injected into the median basilic or median cephalic vein, and the

FIGURE 17 FIGURE 19

Fig. 17: Quimographic record of the cardio-pulmonary circulation in man. The slit of the quimograph is placed in position I.—*Fig. 19:* Quimographic record of the cardio-pulmonary circulation in man. The slit of the quimograph is placed in position II.

time was recorded between the injection and the appearance of the smell in the breath of the subject. This test, suggested by Hitzig, gives in normal persons values which vary from 4 to 8 seconds, which means that from the fold of the elbow to the lung capillaries, the blood takes about 5 seconds.

Other products haye since been used, some to determine the time taken for the blood to pass from the elbow to the tongue, others from the elbow to the face, still others from one arm to the other. Among the first, we will cite decholin and saccharin, in 20 per cent solution and in saturated solution, respectively. The introduction of 5 cc. of one or the other of the two solutions produced in 10 to 15 seconds, a bitter or a sweet taste according to the substance used.

These methods give, however, in healthy individuals, well-marked differences which cannot be attributed to minor errors inherent in any observation. The fact is that they all depend on indications furnished by objective or subjective sensations, and in which the personal factor always superimposes, as everyone knows, differences, at times appreciable, from one case to another.

A test to determine exactly the velocity of the circulation of

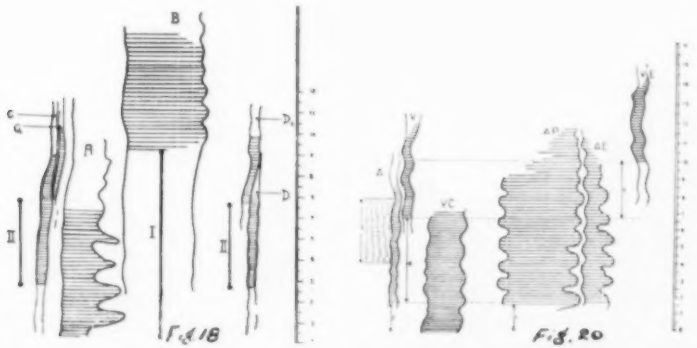

Fig. 18.: Schematic tracing of the previous figure. ‹A› band of the vena cava; ‹B› band of the aorta; ‹CD› bands of the apical arteries; ‹C, D› bands of the apical veins. ‹I› time of the cardio-pulmonary circulation, since it is the distance, which separates the start of the band of the vena cava from that of the aorta. ‹II› time of circulation of the apical segments, since it is the distance which separates the two bands, the arterial and the venous.—*Fig. 20*: Schematic tracing of the previous figure. ‹A and V› band of an artery and of a vein of a right segment; ‹VC› band of the vena cava; ‹AP› band of the trunk of the pulmonary artery; ‹AE› band of the left branch of the AP; ‹VE› band of a vein of a left segment. ‹I› Time of circulation of the right heart, since it is the distance which separates the beginning of the band of the vena cava from that of the pulmonary; ‹4› time of circulation of a pulmonary segment; ‹5› capillary phase, that is the time during which the opaque substance remained in the capillaries of the lung; ‹6› lag of the venous return-circulation.

the blood should, therefore, be planned to give a graphic representation of the passages of the actual blood stream.

In the course of the work of investigating some problems concerning the circulatory disturbances of the lung in different pathological areas, I had occasion to put into practice, with my co-workers Drs. Aires de Sousa and Carlos Vidal, a relatively simple process which facilitates the most exact determination of the lung circulation time. This process consists essentially of the kymographic recording of the entry of an opaque medium into the right auricle, and its subsequent entry into the left auricle.

In order to reach a better understanding of the method, let us schematize the elements on which it is based. Imagine two little cylindrical receivers, B and C (Fig. 11) joined by a rubber tube, thus constituting a communicating system. At one side of these vessels let us suppose that there is an x-ray tube (A), and on the other side a lead plate of a certain thickness which has a horizontal slit half way up, and 2 or 3 millimeters wide (D). And further, that behind the plate is a radiographic cassette loaded with the respective film (E), and that this cassette can be made to move downwards at a given speed.

Suppose now, for a moment, that the tube begins to emit x-rays and that the film begins its slow descent behind the lead screen. The rays traverse in the lead plate to make an exposure of the film. As the cassette is passing downwards at a slow speed, the result is to leave a record on the film, throughout its whole length, of a zone of a width absolutely equal to that of the slit.

If, however, in the course of the experiment, we pour an opaque liquid into the vessel B (a concentrated solution of sodium iodide, for example), the result is that the film reveals no exposure over a small band corresponding to the width of the respective receiver; and, as this is part of a system of communicating vessels, when the solution reaches the other little receiver C, another band will be left unexposed on the film at the side of the first. If we know the speed at which the cassette moves, it can be easily understood that it is simple to calculate with great precision the time that the liquid takes to pass down the rubber tube which joins the two vessels. It is sufficient to measure the distance between the beginning of the two bands. The diagram of Figure 11 shows clearly the mechanism of the experiment.

On the assumption, let us suppose that the two receivers are the two auricles and that the iodine is injected into the median basilic or median cephalic vein. As a low concentration of the product is sufficient to reveal radiologically an alteration of permeability to x-rays which its presence causes, the passage of the

substance referred to through the heart, obviously gives evidence of a greater degree of opacity in the zones corresponding to the right and left cavities at the moment determined by the downward passage of the slit. This alteration appears first on one side, giving rise to a more or less uniform kymographic band, which we can name the *right auriculo-ventricular band* (Fig. 12). A little later, this band widens, corresponding to the arrival of the product in the left-sided chambers. A second band is thus formed beside the first—the *left auriculo-ventricular band*.

The radiographs reproduced in Figures 13, 14 and 15 facilitate the interpretation of the films obtained. As can be seen in the first, the contrast medium can only be observed in the right heart; in the second, the product has invaded the whole of the pulmonary circulation and has begun to enter the left heart; in the third, the cardiac cavities of both sides are already opaque. The distance between the beginning of the two bands, right and left, referred to above, will enable us to discover precisely the

FIGURE 21: The line AB cuts the superior vena cava near the auricle, and a short distance away the axillary vein. If we injected a few cc. of opaxil into the basilic vein, we can catch a glimpse of its passage through the axillary vein, and later through the vena cava.

pulmonary circulation time, since the speed of movement of the film behind the kymographic slit can be previously determined.

If a catheter which reaches the right heart is introduced down one of the jugulars, to pass the auriculo-ventricular valves until it arrives at the ventricular apex in this case, as is to be expected, the opacity of the catheter itself will be recorded first on the kymograph, since the liquid reaches it before it enters the ventricle. The kymographic image will, therefore give, right at the beginning, a narrow strip often showing oscillations which the respiratory movements and the heart beat transmit to the catheter. It is the case of the kymogram reproduced in Figure 12. The opacity of the catheter is recorded first, as you see. A moment later, the opacity corresponding to the entry of the contrast medium into the right-sided cavities appears—it is the right auriculo-ventricular band, with a slightly indented margin. Finally, some seconds later, the left auriculo-ventricular band appears, with its border containing deeper indentations than that of the right, because the contractile movements of the left ventricle are naturally greater and more accentuated.

The number of seconds between the beginning of the two auriculo-ventricular bands obviously give us the pulmonary circulation time. As the film in this case moved with a velocity previously determined of 1.55 cm. per second, the circulation time was, consequently 1.3 seconds. This is without doubt a simple but precise method, for it makes possible the graphic recording of the velocity of the blood in the lesser circulation, without the uncer-

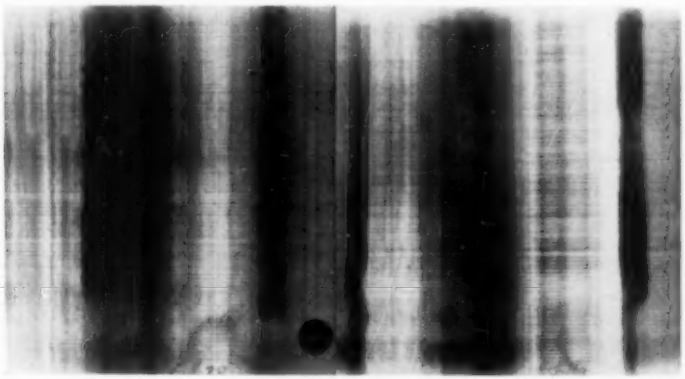

FIGURE 22 FIGURE 24

Fig. 22: Quimographic record of the circulation over the course "axillary vein—vena cava."—*Fig. 24:* Quimographic record of the circulation over the same course. A short pause was made during the injection of the opaque substance.

tainties inherent in the older procedures, all of which were based on the recognition of subjective sensations produced by the injection of certain substances into the veins of the arm.

We have already applied this method to the determination of the pulmonary circulation time in man, and the results obtained exceeded the aim of our experiments. By a simple test, with the injection of opaxil into the median basilic, it is possible to determine with great precision, in addition to the velocity of the entire pulmonary circulation, the time which it takes for the blood stream to pass through the cardiac cavities and the velocity of the circulation in any lobe of the lung.

In man, because of the thickness of the thorax, it is sometimes impossible to observe the passage of the opaque medium through the cardiac cavities; for this reason, it seemed to us to be better to place the kymographic slit not over the heart, but a little higher, at the level of the great vessels. In the angiopneumogram of Figure 16, we can see, marked by a dash, the position of the said slit (Position I). On careful observation, it is seen that it cuts the vena cava, the aorta and the two apical arterio-venous branches of the superior lobes of the lung. The film should record, therefore, various bands, among them those of the vena cava and of the aorta.

On this assumption, let us look at two examples. Let us begin with that of the test to which the film in Figure 17 refers. If unfamiliar with the images obtained, the film naturally appears

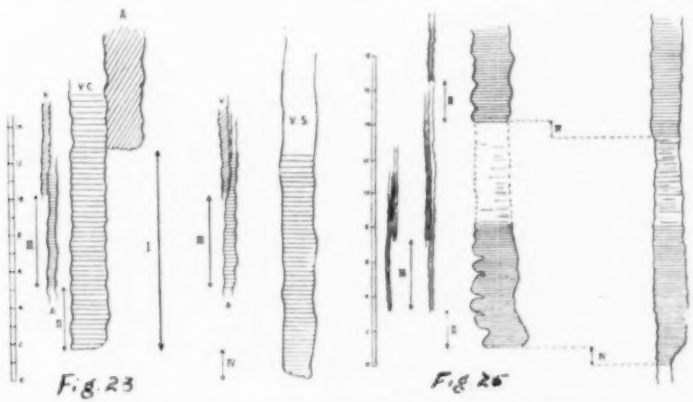

Fig. 23: Schematic tracing of the previous figure. (VC) band of the vena cava. (A) band of the aorta; (VS) band of the axillary vein. (IV time of circulation in the segment "vena cava—axillary vein."—*Fig. 25:* Schematic tracing of the previous figure. During the short interruption of the injection an appreciable quantity of the substance remained in the axillary vein; it was not retained in the vena cava.

very difficult to interpret. But actually it is not. A simple tracing of the elements of greater interest, such as that which is reproduced in Figure 18, greatly facilitates its study. The distances which separate the beginnings of the different bands will, therefore, give us exactly, once the velocity of the movement of the slit is known, the blood circulation time over different sections. As the velocity of the kymograph, in the example given, was 2 cm. per second, it is easy to find for this case the following values: (1) total pulmonary blood velocity, 4.5 seconds; (2) velocity in the apical segments, 2 seconds.

Let us now look at another example, that of the test reproduced in Figure 19 and schematized in Figure 20. The slit of the kymograph in this examination was placed a little lower, in position II (Fig. 16). In this situation it obviously fails to record the passage of the opaque medium through the aorta, for the slit no longer intercepts its ascending part. The bands, we can say, now correspond to the vena cava, to the small vascular branches of the segments, to the trunks of the pulmonary artery and to its left branch. The circulation time of the right heart can therefore be determined with greater precision, for the opaque medium is practically caught at the entrance to the auricle and at the outlet of the ventricle. As the distance which separates the beginning of the two bands was 1.5 cm. and the rate of movement of the slit 2 cm. per second, the intra-cardiac circulation time in this patient was 0.75 second.

The interest of this case does not lie, however, only in the greater precision of this determination. It is, in fact, a test made in a tuberculous patient with left-sided pneumothorax, and this circumstance allows us to record the circulatory disturbances caused by the collapse. For example, one observes a definite delay in the venous return. Actually, the beginning of one of the bands of the right-sided veins (V), appears 1.6 seconds earlier than that of the band of the corresponding vein on the left side (VE).

Further, it is worth recording in this examination, the appearance of the so-called "capillary phase," corresponding to the passage of the opaque medium through the capillary network of the lung. On the right, in fact, an area more opaque to x-rays is to be seen, with a duration of 1.6 seconds and which begins a moment after the bands of the arterial segments start to register.

It was while using this method that we were able to observe that the opaque medium injected into the arm veins for the purpose of angiocardiopneumographic investigation, was not entirely utilized; a large portion was temporarily retained along the wall of the vein. This is easy to demonstrate.

If, in an angiopneumogram, such as is reproduced in Figure 21

we mark the line AB, it is seen to intercept the superior vena cava in the proximity of the auricle, and, at a little distance away, the axillary vein. If, therefore, we take the precaution to place the kymographic slit along this line and inject a few cc. of "opaxil" into the median basilic or median cephalic vein, we can intercept the passage of the solution, first at point A, and afterwards at point B, and thus calculate the velocity of the blood-flow over this short course. This is recorded in the kymogram reproduced in Figure 22 and schematized in Figure 23.

If we now repeat an identical experiment in the same or in another individual, and if, instead of injecting all the product at once, we make a slight pause in the course of the injection, the kymogram will reveal a strange fact: as can be observed in Figure 24, or even better in the diagram (Fig. 25), during the short pause in the injection, the contrast substance remained in appreciable quantity in the axillary vein; it was not retained in the vena cava—it passed on to its destination. This means that in angiopneumographic examinations made by injection into the median basilic or median cephalic, part of the substance is not utilized.

The application of this method to the study of circulatory disturbances which dominate, as no one would deny, the whole of respiratory pathology, should be able to clarify many of the still

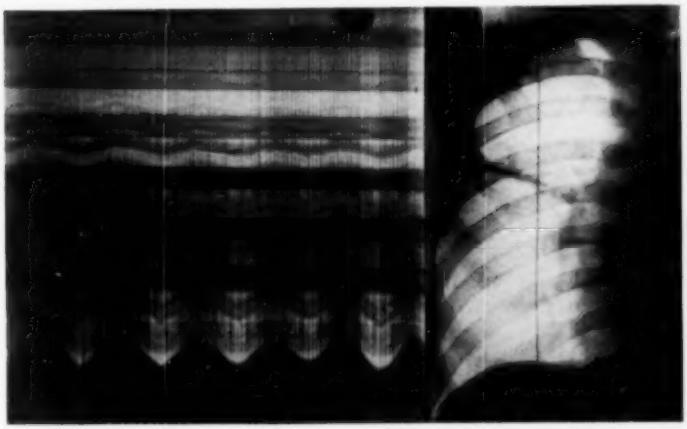

FIGURE 26 FIGURE 27

Fig. 26: Quimographic record of the apex and at the base of the lung.—*Fig. 27:* Figure of the slit of the quimograph for the comparative study of the circulation at the base and at the apex of the lung. The interlobar fissure allows us in the film to separate the two pulmonary fields, the lower and the upper.

obscure problems, in the large chapter of pulmonary diseases.

Here is just one example: Nowadays no one doubts that the usual localization of the tertiary tuberculous lesions is in the upper lung fields and that this selectivity must be related to the blood circulation of the organ. Dusts which come from outside and are carried with the inspired air actually become localized in the middle and lower lobes of the lung, since it is in this direction that the air which enters the bronchial tree finds the least obstruction to its path. The path to the apex is not direct. But this being so, that is, having to evoke the agency of the blood-stream, how can we explain the preference for the localization in the apices? The natural thing to expect would be the appearance without distinction, in any zone of the lung, upper or lower. There must really be some special circumstance existing at the level of the apical regions of the lung, which justifies this preference; hence my statement that everything would lead us to suppose that some factor of a circulatory nature must be the cause.

We sought to throw light on the problem by studying the local circulation with a kymograph with one slit. The slit was placed in a direction parallel to the border of the sternum and in such a way as to cut the median portion of the lung field from above downwards (Fig. 26). The opaque substance, introduced into the lesser circulation by injection into the median basilic, was "opaxil" in a 20 cc. dose. As was to be expected, the kymogram obtained showed a series of vascular bands corresponding to the pulmonary arteries intercepted. The ribs also showed up in the form of regularly spaced shadows.

Let us analyze one of the films obtained, that reproduced in

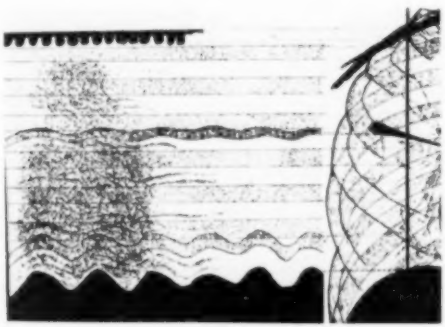

FIGURE 28: Schematic representation of the two previous drawings joined together. The capillary phase is shown greatly accentuated in the lower part of the film; in the region above the fissure, on the contrary, it is less so, which is a proof of the limited activity of the circulation in this zone.

Figure 27, for example. Its interpretation becomes easier if we first trace it (Fig. 28). One fact worthy of mention immediately springs from this analysis: that of the reduced circulation in the upper zone when compared with the increased arterial network found at the base. A special circumstance is present in this kymogram and one which allows the identification of the aforementioned zones with some ease: one corresponds to the upper lobe and the other to the rest of the lung parenchyma. The interlobar fissure, as can be seen in Figure 25, is thickened in this case. From this thickening there has resulted naturally a well-defined kymographic marking which clearly separates the two regions of the lung. The difference is, in reality, marked. While at the base, the diameter of the vessels intercepted is relatively large, at the apex the arteries appear as lines. Besides this, the capillary phase is clearly visible in the lower part of the film, showing that the circulation there is quite vigorous; in the region above the fissure it is, on the contrary, very limited, hardly showing up at all, a clear proof of the slight activity of the local circulation.

Lastly, in the upper zones of the lung the state of the circulation is extremely deficient when compared with the marked flow of blood noted at the bases. This poverty of arterial vessels, all of them reduced in size, and the deficient capillary phase, shown up at the same time, is enough, in fact, to justify the apical localization of tuberculous lesions.

Angiocardiopneumographic methods open up new vistas in the vast field of investigation!

SUMMARY

1) The pioneer work in visualizing the pulmonary vascular bed by angiopneumographic techniques is reviewed.

2) More satisfactory results are obtained by injection of the opaque medium into the external jugular veins than into the arm veins. This is true because the opaque substance passes more readily into the vena cava and thence into the chambers of the heart without being partially retained in the arm veins.

3) An apparatus consisting of a prism on which several x-ray cassettes can be mounted and which can be made to rotate under the examining table permits six or eight rapidly successive films to be made as the contrast medium is injected to visualize the pulmonary vascular bed.

4) Angiopneumography offers proof that many peculiar radiologic shadows of the hilar regions are the result of various positions of the pulmonary arteries rather than hilar adenopathy.

5) Parenchymal tuberculous lesions of the lungs can be demonstrated to have diminished vascularity in contrast to the lung

fields in other inflammatory processes by angiopneumographic study.

6) Collapse of the lung is also associated with a diminution of the vascularity of that lung even in the absence of parenchymal tuberculosis. This may be a factor in the rapid amelioration of toxicity through collapse therapy in tuberculosis.

7) Exact circulation times between parts of the cardio-pulmonary circulatory system can be pictured graphically and measured through kymographic study of the chest using angiopneumocardiographic techniques.

8) Kymographic studies have demonstrated less circulation in the apical areas of the lung as compared with the rest of the lung fields. This difference may account for the tendency toward apical localization of tuberculosis.

RESUMEN

1) Se revisa el trabajo inicial para visualizar la circulación pulmonar por la técnica de la angioneumografía.

2) Se obtienen más satisfactorios resultados inyectando la substancia opaca por la vía de la yugular externa, que por las venas del brazo. Esto es verdad porque la substancia opaca pasa a las cavidades del corazón sin ser retenida parcialmente por las venas del brazo.

3) Se puede emplear un aparato consistente en un prisma con varios chassises que pueden pasar por rotación bajo la mesa de examen, permitiendo tomar de seis a ocho películas sucesivas mientras se inyecta el medio de contraste.

4) La angioneumografía demuestra que muchas sombras radiológicas peculiares del hilio resultan de las varias posiciones de las arterias pulmonares y no por adenopatía.

5) Por el estudio angioneumográfico se demuestra que las lesiones parenquimatosas tuberculosas del pulmón, tienen una vascularización disminuida en contraste con otras lesiones inflamatorias del pulmón.

6) El colapso del pulmón también está asociado con una disminución de la vascularización en el pulmón aún en ausencia de lesión tuberculosa. Esto puede ser el factor en la ráida mejoría de la toxicidad por medio del colapso en tuberculosis.

7) Los tiempos exactos de la circulación pueden ser visualizados gráficamente y medidos por quimografía usando las técnicas de la angiocardiografía.

8) Los estudios kimográficos han demostrado menos circulación en las areas apicacales del pulmón comparando con el resto de los campos pulmonares. Esta diferencia puede estar en relación con la tendencia a la localización apical de la tuberculosis.

Discussion

ISRAEL STEINBERG, M.D., F.C.C.P.
New York, New York

Throughout the world everyone knows that Prof. Lopo de Carvalho and his colleagues in 1931 were the first to make use of the cardiac catheterization technique of Forssmann to visualize the pulmonary arterial tree.

Dr. George Robb and I felt that there should be an easier way to accomplish visualization of the pulmonary artery and in 1936 we began the animal studies which finally by a simple rapid intravenous injection of 70 per cent Diodrast, not only opacified the pulmonary artery but also the superior vena cava and its tributaries, the right atrium and ventricle, the pulmonary veins, the left atrium and ventricle and the thoracic aorta and its branches. Our method, published in 1938, has proved to be practical and safe. We have studied over 2,000 adult patients without mortality.

We have confirmed everything Prof. Carvalho has to say about the arterial constitution of the hilar shadow and their differentiation from neighboring lymph nodes. We, too, verified the avascularity of tuberculous parenchymal lesions and the diminished vascularity of the lungs produced by artificial pneumothorax.

The greatest value of angiocardiography in mediastinal and lung disease has been in the differentiation of tumor masses from aneurysm of the aorta or pulmonary artery. Recently at The New York Hospital and Cornell University Medical College, Drs. Dotter, Andrus and I brought our experience in this field up to date and emphasized the value of angiocardiography preoperatively. Drs. Dotter, Holman and I have also completed an angiocardiographic study of 50 microscopically proved cases of lung cancer and discussed the value of angiocardiography in predicting operability of the cancer.

With the advent of new surgical techniques for the correction of congenital heart lesions, angiocardiography has become of great importance as a diagnostic aid in the selection of the proper cases for surgery and in planning the type of surgical procedure. In late syphilis our group at The New York Hospital has demonstrated that early syphilitic aortitis can be recognized by angiocardiography even in the absence of physical signs and conventional roentgenography findings.

Drs. Dotter and Jackson have recently circularized the hospitals in this country and Europe and it has been a source of great satisfaction to learn how widely used has become our method. Drs. Dotter, Temple and I at The New York Hospital have recently

developed an automatic magazine made by the Fairchild Camera and Instrument Company which promises to revolutionize the recording of the angiocardiographic image. We are able to make exposures regularly every half second at a distance of six feet on a 9½ x 9½ inch roll film for the entire duration of the cardiovascular opacification.

Prof. Carvalho's recording of the circulation time on a roentgenkymograph, while interesting, is of academic rather than of practical importance. The recording of the circulation time with the Geiger counter, after an injection of a radioactive substance, is simpler and much less uncomfortable for the patient. Furthermore, the circulation times of the various components of the cardiovascular system can be calculated directly from the serial angiocardiograms made with the automatic magazine.

Closing Remarks

Lopo de Carvalho, M.D., F.C.C.P., Lisbon, Portugal: I would like to thank the discussor of my paper. The automagazine made by the Fairchild Camera and Instrument Company needs a special kind of film and only gives the possibility of recording angiocardiographs of 9½ x 9½ inches, while the model I described, allows the employment of ordinary film 30 x 40, making a radiograph every half second.

For the determination of circulation time the procedure I propounded is much more rigorous than all the other methods, besides recording radiographically the circulation time.

Again we cannot affirm that it is uncomfortable for the patient, as all we need is an injection in the vein of the arm.

Finally the determination of circulation time calculated from the serial angiocardiograms made with the automatic magazine, besides being expensive, may lead to gross mistakes; one has to remember that the images are recorded only every half second.

Primary Chondromas of the Lung*

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Reports in the literature often confuse chondromas with hamartomas. These two tumors are distinct and different forms of neoplastic disease. A chondroma of the lung is a cartilagenous tumor in the substance of which there may be some other connective tissue elements chiefly osseous and fibrous tissue. A hamartoma, as defined originally by Albrecht (1904), is a "Tumor-like formation in which there is an abnormal arrangement of the normal components of that organ. The abnormality may take the form of a change in quantity, arrangement or degree of differentiation or may comprise all three phases." Thus, the hamartoma will contain cartilagenous elements but is not chiefly comprised of that tissue. Moller (1933) referred to these growth as "mixed tumors" and believed that the cartilage formation in the stroma was brought about by a specific inductive effect of the proliferating epithelium in the connective tissue within the pulmonary parenchyma.

Chondroma of the lung is a rare tumor. In a series of 4,800 autopsies performed at the Jewish Hospital of Brooklyn only two (less than 0.05 percent) pulmonary chondromas were encountered. Verga (1932) in a series of 28,000 autopsies also encountered only two such tumors. Although a number of so-called chondromas of the lung found their way into medical literature prior to 1847, it was not until that year that the first authentic case was reported (Hickey and Simpson). In 1932 Verga was able to collect 58 cases of chondroma of the lung reported in various journals to which he added three previously unreported cases. Since that time the writers have found additional reports of 14 cases and are adding three other cases previously unreported—making a total of 78 cases. In the collected series the overall sex incidence was 50 males to 13 females; in the other 15 cases the sex of the patient was not mentioned. Although the tumor may occur in persons of almost any age, it is most common after the fourth decade of life—almost 80 per cent of the cases occurring in persons over 40 years of age. Adamson (1912) reported a chondroma

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of the lung in a nine year old boy, and Bayer (1929) reported a similar tumor in an 81 year old female.

Age in Years	Verga	Authors	Total
to 10	1		1
11 to 20	1	2	3
21 to 30	3	2	5
31 to 40	3	1	4
41 to 50	5	3	8
51 to 60	9	3	12
61 to 70	16	4	20
71 to 80	6	1	7
81 to 90	1	1	2
TOTAL	45	17	62

The right lung is more commonly involved in this neoplastic process than the left. In the 62 cases in which the location of the tumor was given, 38 were found in the right lung and 24 in the left lung.

Right Upper Lobe	7	
Right Middle Lobe	2	
Right Lower Lobe	18	
Site in right lung not mentioned	11	
Total arising on the right side		38
Left Upper Lobe	11	
Left Lower Lobe	9	
Site in left lung not mentioned	4	
Total arising on the left side		24

There are two theories of the origin of chondromas of the lung, both of which are plausible in explaining the genesis of some of these tumors. The first is predicated on the assumption that irritation of the bronchial wall will cause hyperplasia of the cartilage and tumor formation. This view would explain the origin of some of the tumors found within the confines of the bronchial wall. The second and more generally accepted theory is that these tumors arise in embryonic rests where there has been delay in development of the cartilagenous elements. The fact that these tumors are found occasionally in the substance of the lung close to its surface, has lead some investigators to repudiate this theory. If one remembers that in the development of the lung the centers which form the cartilage in the mesodermal syncytium of the

bronchial wall are widespread and that the lung grows rapidly after the bronchial wall is developed, it is readily seen that the expansion of the lung after birth may displace some of these aberrant elements which eventually may give rise to intraparenchymal chondromas.

Chondromas of the lung are variable in size—the smaller ones being generally attached to a larger bronchus whereas the larger tumors are usually located in the pulmonary parenchyma. These tumors are usually discrete and generally do not invade the surrounding lung tissues. They may be freed from the lung tissue with comparative ease. The size varies from that of a fraction of a centimeter in diameter to that described by Linser which was 20 x 16 x 9 cms. While these neoplasms are generally solitary growths they also may be multiple. Virchow reported a case in which there were three chondromas in one lung—one at the root of the lung, another in the parenchyma and a third in the pleural region.

These tumors are roun dor ovoid in shape, have a lobated surface, are fairly firm in consistency and are covered by a semitranslucent fibrous capsule. On cutting across the tumor there may be noted a grating sensation suggesting the presence of firmer tissue within the neoplasm. The cut surface of the tumor is greyish-white in color with a bluish cast and contains islands of boney hard calcific deposits. Trabeculae pass from the capsule into the tumor dividing it into lobules. The accompanying changes in the surrounding lung tissue depend upon the location, size and duration of the primary tumor. Large tumors within the lung may produce compression of the surrounding lung tissue. Tumors arising in the bronchi may cause erosion of the mucosa with local inflammatory changes. In those instances in which the tumor is large enough to produce bronchial obstruction there may ensue distal atelectasis, bronchiectasis and suppuration. Microscopic examination of the tumor reveals nests of hyalin and fibrocartilagenous tissue separated from each other by fibrous connective tissue stroma. Histologically these tumors simulate normal cartilage. The fibrous tissue capsule and trabeculae often contain small vessels. Within the substance of the tumor there may be noted calcific deposits and rudimentary bone formation. At other times there may be noted bleeding into the tumor, myxomatous degeneration and sarcomatous transformation.

The symptoms induced by chondroma of the lung are dependent upon its location, size, duration and effects upon the surrounding tissues. In many instances it is entirely asymptomatic and unexpectedly discovered at necropsy. The neoplasm which grows in the region of the main bronchus will produce symptoms characterized chiefly by bronchial irritation namely, cough. However,

when the growth encroaches upon the lumen of the bronchus or produces edema of the bronchial wall it may cause asthmatoid symptoms and dyspnoea. Tumors growing in the pulmonary parenchyma will remain asymptomatic until they cause erosion of a vessel at which time the patient will have hemoptysis. Tumors arising at the periphery of the lung are characterized by local pain and when they are close to the chest wall they give rise to symptoms characterized chiefly by referred pain. In view of the fact that these tumors grow slowly the symptoms will be minimal and transitory until they reach a fairly large size or interfere with the function of the surrounding tissues. At any stage or location the entire clinical syndrome may be masked by the attending secondary changes in the neighboring tissues—the lung, heart, mediastinum, esophagus, pleura, chest wall and/or diaphragm. There are neither signs nor symptoms pathognomonic of this condition. In the 17 cases we reviewed three were entirely asymptomatic and discovered only at necropsy.

Examplary cases have been reported by many authors. Davidson (1941) reported the case of a 66 year old man who had an *intractable cough for many years*. Studies revealed that the patient had a chondroma *within the lumen of the right main descending bronchus*. Klages (1931) reported the case of a 29 year old female who gave a history of *cough and hemoptyses*. An exploratory thoracotomy revealed a *chondroma 7 x 6 cm. in diameter within the right lower lobe*. In 1940 Capella reported the case of a 27 year old man whose chief complaints were *pain in the right paravertebral area* opposite the eighth, ninth and tenth intercostal spaces and dull pain in the right hypochondrium which was more severe on reclining. An exploratory thoracotomy revealed a *chondroma of the lung just deep to the eighth and ninth ribs*. The eighth rib was partly eroded by pressure of the tumor.

The diagnosis of chondroma of the lower respiratory system may be facilitated by roentgenographic and bronchoscopic examinations. It should be pointed out at the very outset that many of these tumors are too small to be recognized on the roentgenograms while others do not involve the bronchial wall or lumen within the field of bronchoscopists field of visualization. In the typical case roentgenographic examination of the chest in the postero-anterior and oblique projections will reveal a circumscribed round or oval opaque mass which is well delineated from the surrounding aerated lung tissue. These tumors are of variable size and as has already been pointed out, may occur in any part of the lung field. The tumor has a distinctly nodular border about which there is rarely seen any appreciable inflammatory change. Within the opacity cast by the tumor there may be noted

patchy areas of greater density. These roentgenographic characteristics of the chondroma of the lung are best seen on stereoscopic and tomographic studies of the lungs. Bronchoscopy is not of much help in the diagnosis of chondroma of the lung except in those instances in which the tumor involves the bronchial wall or has grown into the lumen of the bronchus. In these instances the tumor is seen as a nodular mass, covered by a fibrous capsule. When pressed upon by the distal end of the bronchoscope tube there is noted considerable resistance to the pressure. Those rare instances in which such a neoplasm is visualized through the bronchoscope also permit the removal of representative tissue for biopsy purposes.

In recording his observations on the radiosensitvity of tumors derived from cartilage Desjardins (1933) concluded that radiotherapy may prove a distinct boon in a number of cases. However, he did not refer directly to pulmonary chondromas. The few (unproved) cases of chondroma of the lung treated by x-ray did not give encouraging results. In view of the fact that the clinical diagnosis is not always certain and that surgical intervention permits the removal of any other tumor which may be encountered during the operation, this procedure is the one of choice in the treatment of such tumors.

Case 1: A 61 year old man entered the hospital complaining of progressive dyspnoea for about five years, becoming quite pronounced several weeks before admission to the hospital. The physical signs including x-ray inspection of the chest did not contribute toward a diagnosis of chondroma of the lung. Three days after admission to the hospital he died. At autopsy there was found (1) generalized arteriosclerosis, (2) bilateral bronchopneumonia, (3) patent foramen ovale and (4) chondroma of the right lung.

The surface of the right lung was crepitant throughout. In the cut section of the right middle lobe there was a nodular, firm mass 1.2 x 1.2 x 1.0 cms. It was yellowish-grey in color. This nodule consisted of shrunken cartilage cells in lacunae lying singly and in small groups within a fibrillary matrix. The surrounding bronchioles were compressed.

Case 2: An 81 year old man entered the hospital complaining of headache, dizziness, weakness and dyspnoea. The night before admission to the hospital he lost consciousness for several hours. He died two days after admission to the hospital. The clinical diagnosis before death was (1) arteriosclerotic heart disease, (2) hemiplegia and (3) diabetic coma. The necropsy diagnosis was (1) generalized arteriosclerosis, (2) myofibrosis cordis, (3) focal pneumonia of the right upper and middle lobes and (4) chondroma of the right lung.

Within the substance of the right upper lobe there was found a firm greyish discrete nodule measuring about one centimeter in diameter. Microscopic examination of the nodule showed a well circumscribed cartilagenous tumor.

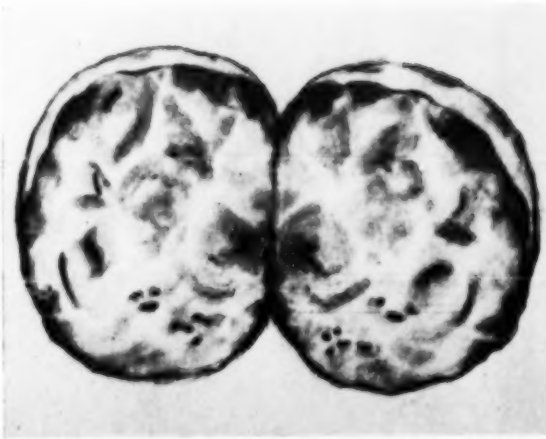

FIGURE 2

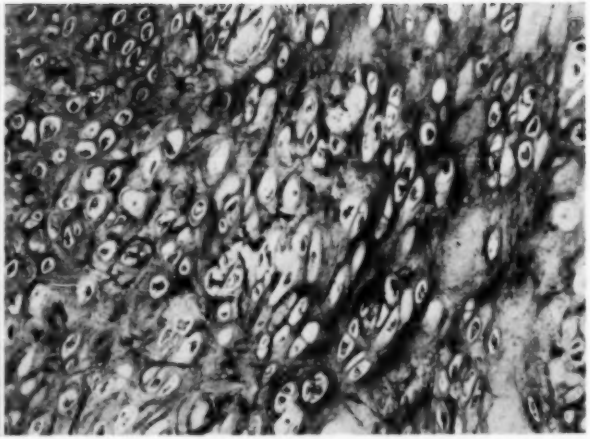

FIGURE 3

Figure 2: Sketch of the tumor of the lung which was removed surgically, measuring 3 x 2.5 x 2.3 cms. — *Figure 3:* Photomicrograph of the tumor (magnification 100x).

Case 3: A 37 year old man entered the hospital on December 20, 1947 complaining of recurrent hemoptyses ever since November 21, 1947 when he sustained an injury to the chest. Prior to that date the patient did not have any symptoms referable to the chest or abdomen. The physical examination at the time of admission to the hospital was entirely negative. An x-ray of the chest taken on November 23, 1947 and another on December 12, 1947 showed an irregular dense shadow opposite the eighth rib posteriorly (Fig. 1). There was no appreciable roentgenographic change in the size of the tumor in the three week interval between the two roentgenographic studies. The diagnosis on admission to the hospital was "benign tumor of the lung"—possibly hamartoma or chondroma.

On December 22, 1947 an exploratory thoracotomy was performed after resection of the seventh rib posteriorly. On entering the pleural cavity a small irregular, firm tumor was palpated in the apical region of the right lower lobe, about half an inch deep to the posterior surface of the lung. An incision was made over the tumor and the neoplasm shelled out (Fig. 2). The incised area in the lung tissue was sutured and the wound closed in layers after the lung was inflated.

The pathologist's report on the tumor was as follows: The tumor consists of an ovoid mass of firm tissue measuring 3 x 2.5 x 2.3 cms. The outer surface is coarsely nodular, grey, white and red in color. The cut surfaces are smooth and grey-blue and have closely folded branching layers of grey tissue separated by delicate pale and red septa. Microscopic examination (Fig. 3), shows sheets and nests of cartilage making up the greater part of the preparation. In places the cartilage cells are closely squeezed together. In other areas the cells are further apart and in an abundant matrix. The cartilage cells vary in size, shape and contents. Many have abundant cytoplasm with irregular and wrinkled outlines shrunken away from the matrix. The nuclei are deeply staining and of

FIGURE 1: Postero-anterior roentgenogram of the chest showing an irregular dense opacity behind the eighth rib posteriorly.

variable position in the cell. For the greater part, the sheets of cells have convoluted or gyrate outlines and are separated by narrow or broad clefts, and sulci at the periphery. Within these clefts or sulci there is loose delicate fibrous connective tissue often traversed by narrow channels lined by cuboidal or small cylindrical cells with scant cytoplasm and deeply staining nuclei. Near the periphery some of the sheets of cartilage are split into heavy rounded cords surrounded by the previously described connective tissue. Diagnosis: Chrondoma of the lung.

When seen recently, two and a half years after the operation, the patient's condition was satisfactory. There has been no recurrence of hemoptyses since the day of the operation and repeated roentgenographic examination of the chest showed no evidence of recurrence of the tumor.

SUMMARY

1) Primary chondroma of the lung is an uncommon condition.

2) It may occur in any part of the lung field.

3) Symptoms depend upon its location, size, duration, and secondary effects upon the surrounding tissues.

4) In view of the fact that the clinical diagnosis is not always definite and that it may undergo sarcomatous changes, surgical extirpation is recommended.

RESUMEN

1) El condroma primario del pulmón es un estado poco común.

2) Puede aparecer en cualquiera parte del campo pulmonar.

3) Los síntomas dependen de su ubicación, tamaño, duración y efectos secundarios sobre los tejidos circundantes.

4) Se recomienda la extirpación quirúrgica debido al hecho de que no siempre se puede hacer el diagnóstico bien definido y de que pueden ocurrir alteraciones sarcomatosas en el tumor.

REFERENCES

Adamson: Cited by Verga.

Albrecht, E.: "Ueber Hamartome," *Verhandl der Deutschen Path. Gesell.*, 7:153, 1904.

Bayer, R.: "Beitrag zur Kenntnis der Sog. Lugen-Enchondrome," *Virch. Arch. f. Path. Anat.*, 274:350, 1929.

Benninghoven, C. D. and Peirce, C. B.: "Primary Chondroma of the Lung," *Am. Jour. of Roent.*, 29:805, 1933.

Boyd, W.: "Surgical Pathology," Philadelphia, *W. B. Saunders Company*, Sixth Edition, 1947.

Capella, F.: "Clinical and Histopathological Observations on a Case of Pulmonary Chondroma," *Boll. della Soc. medico-chirurgica*, 54:427, 1940.

Chiari: "Zur Kenntnis der Bronchialgeschwulste," *Prager Med. Woch.*, 8:497, 1883.

Cid, J. M.: "Pulmonary Hamartochondromas," *Anales de Cirugia*, 6:285, 1940.

Clinical Pathologic Conference Report: "A Case of Enchondroma," *Bul. of U. S. Army Med. Dept.*, 8:76, 1948.

Davidson, M.: "A Case of Primary Chondroma of the Bronchus," *Brit. Jour. of Surg.*, 28:571, 1940-41.

Desjardins, Arthur U.: "The Radiosensitiveness of Tumors Derived from Cartilage," *Am. Jour. Cancer*, 18:15, 1933.

Von Eicken, C.: "Bronchoscopische Mitteilungen," *Verhandl. d. Vereins Sud. Dent. Laryng.*, 1907. (Cited by M. C. Meyerson).

Edling, N. P. G.: "A So-called Chondroma of the Lung," *Acta Radiologica*, 19:44, 1938.

Ewing, James: "Neoplastic Diseases," Fourth Edition, Philadelphia and London, *W. B. Saunders Company*, 1940.

Figi, F. A.: "Chondroma of the Larynx: Report of Six Cases," *Ann. Otol., Rhin .an dLaryng.*, 41:369, 1932.

Flint, J. M.: "The Development of the Lungs," *Am. Jour. Anatomy*, 6:1, 1906-07.

Gebauer, P. W.: "A Case of Osteochondroma of the Bronchus," *Ohio State Med. Jour.*, 34:398, 1938.

Goldsworthy, N. E.: "Chondroma of the Lung (Hamartoma Chondromatosum Pulmonis), With Report of a Case," *Jour. Path. and Bact.*, 39:291, 1934.

Greenspan, E. B.: "Primary Osteoid Chondrosarcoma of the Lung: Report of a Case," *Am. Jour. Cancer*, 18:603, 1933.

Gurney, R. and Cohen, L.: "An Unusual Case of Multiple Chondromata," *Radiology*, 46:48, 1946.

Hickey, P. M. and Simpson, W. M.: "Primary Chondroma of the Lung," *Acta Radiol.*, 5:475, 1926.

Hochberg, L. A.: "Roentgenographic Images in Primary Carcinoma of the Lung," *Radiology*, 32:713, 1939.

Jaeger, L.: "A propos de quelques oas de 'chondromes pulmonaires' (les hamartomes pulmonaires: hamarto-chondromes et hamarto-kystomes)," *Ann. d'anat. path.*, 12:811, 1935.

Karsner, H. T. and Sanford, A. H.: "The 1947 Year Book of Pathology and Clinical Pathology," Chicago, *The Year Book Publishers*, 1948.

Kettle, E. H.: "The Pathology of Tumors," Second Edition, London, *H. K. Lewis and Company*, 1925.

Klages, F.: "Uber die Chondrome der Lunge," *Beitr. z. Klin. Chir.*, 151: 661, 1931.

Livingston, S. K.: "Primary Chondroma of the Lung. Case Report," *Virg. Med. Monthly*, 62:589, 1935-36.

Linser: Cited by Verga.

Mallory, T. B.: "Case Reports of the Massachusetts General Hospital (Case 24261)," *New Eng. Jour. Med.*, 218, 1105, 1938.

McDonald, J. R., Harrington, S. W. and Clagett, O. T.: "Hamartoma (Often Called Chondroma) of the Lung," *Jour. Thor. Surg.*, 14:128, 1945.

McGlumpky, C. B.: "A Special Form of Chondroma of the Lung," *Jour. Cancer Res.*, 8:482, 1924.

Moller, A.: "Zur Entstehung der Lungenmischgeschmulste," *Virch. Arch.*, 291:478, 1933.

Moore, R. A.: "Ueber ein Polyposes Chondrom des Bronchus," *Centralb. f. Allg. Path. u. Path. Anat.*, 55:321, 1932.

Myerson, M. C.: "Benign Neoplasms of the Bronchus," *Am. Jour. Med. Soc.*, 176:720, 1928.

Nicholson, C. W.: "The Nature of Tumor Formation," (The Erasmus

Wilson Lectures delivered before the Royal College of Surgeons of England on February 23, 25 and 27, 1925), Cambridge, *W. Heffer and Sons, Ltd.*, 1926.

Ogilvie, R. F.: "Pathological Histology," Third Edition, Baltimore, *The Williams and Wilkens Company*, 1947.

Paul, F.: "Bronchostenose durch ein Polyposes Myxochondrom des Bronchus," *Monatschr. f. Ohrenh*, 64:669, 1930.

Peters, R.: "Ueber das sogenannte lungenchondrom," *Beitr. z. path. Anat. u. z. allg. Path.*, 89:484, 1932.

Pouey, E.: "Chondroma of the Lung," *Arch. Uruguayos de Med., Cirugia y Espec.*, 17:93, 1940.

Rosedale, R. S.: "Laryngeal Chondroma," *Arch. Otolaryngology*, 45:543, 1947.

Seifert, E.: "A Case of Successfully Operated Chondroma of the Lung," *Zentr. f. Chir.*, 69:1275, 1942.

Sherwood, K. K .and Sherwood, H. H.: "Enchondromata of the Lung, With Report of a Fatal Case," *Journal-Lancet*, 52:395, 1932.

Vanzetti, F.: "Su di un Tumore Misto Encondromatoso del Polmone," *Arch. per le sc. Med.*, 51:401, 1927.

Verga, P.: "I Condromi del Polmone," *Pathologica*, 24:1, 1932.

Viannay, C.: "Deux Cas de Chondrome," *Loire Med.*, 45:348, 1931.

Willis, R. A.: "Pathology of Tumors," *Butterworth and Company*, London, England, *The C. V. Mosby Company*, St. Louis, Missouri, 1948.

Womack, N. A. and Graham, E. A.: "Mixed Tumors of the Lung. So-Called Bronchial or Pulmonary Adenoma," *Arch. Path.*, 26:165, 1938.

Broncho-Esophagology

A Critical Review

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It is difficult to review progress in one branch of medicine without taking into consideration the contributions that have been made in other fields and that applies to progress in broncho-esophagology. One must take into consideration the advances made in the diagnosis of bronchopulmonary diseases in other fields, notably by roentgenology, the influence of the antibiotics and the remarkable progress in the field of thoracic surgery which in turn owes much of its advances to antibiotics, to a greater knowledge of bronchopulmonary physiology, to broncho-esophagology and to advances in anesthesia.

One of the outstanding contributions in the field of physiology was that by the Hildings[1] who studied the volume of the bronchial tree at various levels and speculated concerning the physiological significance, particularly on the matter of cleansing inspired air. While there was not observed a great increase in the volume of the tracheobronchial tree from the larynx to the bronchi measuring 1.5 mm. in diameter, they found a remarkable expansion in the volume of the tract in the bronchi less than 1.5 mm. in diameter. It was their opinion that this distal portion of the air passageway might be considered as a bronchiolar filter and that it probably was more effective in the matter of dust removal and humidification than the nose.

Bronchospirography is attracting more attention particularly to determine the function of the separate lung. Norris[2] and his associates have been carrying out studies in this field to ascertain the extent of participation of the separate lungs in the various phases of the total respiratory function in health as well as disease.

The field of anesthesia as it pertains to broncho-esophagology has come in for a great deal of discussion. The whole problem still is unsettled. The development of certain synthetic anesthetics for topical application and instillation and the employment of sodium pentothal and curare have changed the entire picture as compared with anesthesia of 10 years ago. A majority I believe prefer local anesthesia supplemented by barbiturates or other sedatives.

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For the recognition of certain congenital cardiovascular anomalies endoscopic procedures in the newborn are becoming more important. Heretofore the most common anomaly recognized was congenital esophagotracheal fistula but it was only recently that the thoracic surgeon has been able to treat it successfully. Heatley and Emerson[3] contributed an interesting paper on this subject and analyzed a series of 50 cases of bronchoscopies performed in new-born infants. A majority were performed within the first 24 hours of life. In many the indications were those of respiratory distress which persisted in spite of the commonly employed methods of conservative treatment. It was their opinion that bronchoscopy can be carried out with comparative safety in infants.

Holinger[4] and his associates discussed congenital cardiovascular anomalies which produce tracheal and bronchial obstruction and emphasized particularly that laryngoscopy and bronchoscopy often may be more informative than roentgen studies.

Acute laryngotracheobronchitis now seems to be taken care of remarkably well by the antibiotics, without or with sulfadiazine, and humidification together with postural drainage and careful nursing attention. Tracheotomy is not as commonly employed as formerly and it is the opinion of many observers that bronchoscopy rarely is required. The report of Davison[5] is of interest in this connection.

The employment of antibiotics either by bronchoscopic instillation or as medicated aerosal always has been of interest to bronchologists, and considerable literature is accumulating. Many of the reports are extremely optimistic. One cannot help but hark back to the days when the sulfonamides also enjoyed a remarkable popularity and were insufflated in powder form or instilled in solution and amazing claims were made. At the present time no one contemplates using any of the sulfonamides bronchoscopically. While the situation may be somewhat different with the antibiotics one's enthusiasm should not impair one's clinical judgment. Prigal[6] who has contributed a number of papers on this subject made an interesting observation, namely, that there may be a temporary storage of the aerosal somewhere in the lungs as that was the only way he could explain the prolonged blood levels obtained with penicillin. It suggested to him that other forms of medication in aerosol form might possibly be introduced through the lungs for systemic purposes. He found that administering aminophyllin by aerosol in asthmatics at times succeeded even after failure when given intraveneously.

Hagens[7] and his group have employed penicillin inhalation therapy in a number of chronic pulmonary conditions and found

that it was a useful adjunct to other forms of therapy. They observed few complications.

Krasno[8] and his associates employed a penicillin dust by inhalation and considered this an effective as well as a practical method in the treatment of many types of infection of the respiratory tract.

Tuberculous tracheobronchitis still constitutes a problem of interest to not only the phthisiologist but bronchologists as well. Irrespective of the development of these lesions their occurrence is of serious prognostic import.

There has always been a question whether bronchoscopy in the tuberculous might aggravate or increase the likelihood of spread. Coates[9] studied the effects of bronchoscopy in a series of almost 500 cases. It was his final conclusion that there was no tendency for a post-bronchoscopic increase in lesions and in his group of cases the incidence was no greater than in patients who did not have bronchoscopy.

While streptomycin first employed by Hinshaw and Feldman has changed our concepts of management of pulmonary tuberculosis it also has changed the outlook in the case of tuberculous tracheobronchitis.

O'Keefe[10] reported his results of therapy in known cases of tuberculous tracheobronchitis and it was his conclusion that the concomitant parenteral and aerosol method of administration of streptomycin appeared to be the method of choice. Patients were given one gram of streptomycin parenterally and one half gram by nebulization during the 24 hour period. The results were impressive.

With the increasing use of intratracheal or endotracheal tubes for anesthesia reports of granuloma of the larynx have appeared in the literature. It is difficult to know why these occur since they cannot necessarily be attributed to trauma at the time of introduction of the airway. Hill[11] and others who have reported on these have emphasized the importance of mirror laryngoscopy in every patient who develops hoarseness following intratracheal anesthesia.

While injury of a bronchus as a complication of nonpenetrating external trauma to the chest has been recognized, a majority of these cases were not discovered until cicatrization was complete and atelectasis of a lobe or an entire lung was discovered. Three cases were reported by Holinger[12] and his associates and Hodes[13] and his co-workers reported a case. With the development of acrylic and lucite molds which may be inserted into the air passageway as demonstrated by Longmire in the repair of a large defect of the trachea the question comes up whether it might not

be feasible to contemplate this type of procedure if the rupture was discovered shortly after the accident occurred.

With a lowering mortality rate following pneumonectomy for carcinoma of the bronchus it becomes more important that the diagnosis of carcinoma be made before metastasis has occurred. A report by Norris[14] indicated that only 12.9 per cent in a series of 269 consecutive cases of proved carcinoma of the bronchus were resectable, this in spite of the fact that a positive bronchoscopic biopsy was secured in over 70 per cent. It is evident that if one waits for a positive bronchoscopic biopsy before a diagnosis of carcinoma of the bronchus is made few cases will be operable. Fortunately cytologic study of bronchial secretions has aided enormously in this field and in a number of clinics studies of bronchoscopically removed secretions or sputum may give a positive diagnosis in from 80 to 90 per cent. Of particular interest was the finding of cancer cells in a large number of patients in whom bronchoscopy was absolutely negative. A recent study of operated cases indicated that operability rates are much higher in the groups where bronchoscopy is negative and cytology is positive. This is one of the outstanding contributions in the field of diagnosis in bronchial diseases.[15] In the field of esophagology probably the outstanding development within the past few years is the remarkable success attained by chest surgeons in the treatment of carcinoma of the esophagus. This has its counterpart in bronchogenic carcinoma both from the standpoint of treatment and particularly from the standpoint of diagnosis for here, too, diagnoses are made late and few patients reach surgery at a time when the lesion is resectable, this in spite of the fact that the entire esophagus can now be removed with comparative safety.

There also has been a more general recognition of hiatal hernia and the literature contains many articles. Olsen[16] directed attention to the possibility of frequent esophagitis as being a possible cause for cicatrization and shortening of the esophagus that sometimes is encountered in esophageal hiatal hernia. It is thought that the reflux of gastric acids into the esophagus is responsible for these recurrent attacks of esophagitis.

While we recognize that sclerosing of esophageal veins is of value in portal cirrhosis, MacCormick[17] directed attention to its importance in the treatment of esophageal varices in patients suffering from Manson's schistosomiasis. He indicated that about one out of four patients suffering from this disease have fatal exsanguinating hemorrhages. It is his opinion that splenectomy and sclerosing of varices is the treatment of choice.

Strictures of the esophagus always will present difficult therapeutic problems. With the Salzer method instituted promptly,

results are remarkably good but unhappily a majority of patients do not consult a physician until there is cicatrization. Recent advances in the surgical treatment have permitted resection of annular strictures with apparently good results.

Foreign bodies still are bronchologic as well as esophagologic problems and one still sees large series of cases reported in the literature. In spite of advances in the field of thoracic surgery the removal of foreign bodies remains a problem for the broncho-esophagologist.

SUMMARY

Progress in any branch of medicine is dependant on contributions in other fields. In bronchoesophagology it is dependant on advances in anesthesiology, roentgenology and thoracic surgery and the influence of the antibiotics. Among the advances are:

1) The need for more endoscopic study of infants to detect congenital anomalies which now can be successfully treated surgically. In certain cases endoscopy is more important than roentgen study.

2) Tuberculous tracheobronchitis constitutes a problem. Bronchoscopy is invaluable in the diagnosis and studies have shown that it does not aggravate or increase the likelihood of spread. Streptomycin has aided immensely in the treatment of tuberculous tracheobronchitis. The concomitant parenteral and aerosal administration appears to give the best results. One gram parenterally and 0.5 grams by nebulization are given during a 24 hour period.

3) With lowering mortality rates following pneumonectomy the outlook in bronchogenic carcinoma should improve. Cytologic examination of bronchoscopically removed secretions or sputum have aided enormously and many cases with negative bronchoscopic findings now are diagnosed by cytology as carcinoma and treated successfully. Studies indicate that operability rates are higher in cases where bronchoscopy is negative and cytology is positive.

4) There is an increasing interest in hiatal hernia since many of these cases are not suitable for surgery and mechanical treatment is required. Recurring esophagitis is considered as a possible cause for the cicatrization and shortening of the esophagus in these cases.

RESUMEN

El progreso en cualquiera rama de la medicina depende de contribuciones en otros campos. En la broncoesofagología depende de avances en la anestesiología, roentgenología y cirugía torácica y la influencia de los antibióticos. Entre los avances se encuentran los siguientes:

1) La necesidad de más estudios endoscópicos de los niñitos para descubrir anomalías congénitas que ahora pueden ser tratados con buen éxito por medios quirúrgicos. En ciertos casos la endoscopía es más importante que el estudio roentgenográfico.

2) La tráqueobronquitis tuberculosa constituye un problema. La broncoscopía es invaluable en el diagnóstico y los estudios han demostrado que no agrava o aumenta la posibilidad de extensión. La estreptomicina ha ayudado inmensamente en el tratamiento de la tráqueobronquitis tuberculosa. La administración sistémica y por aerosol concomitante parece dar el mejor resultado. Se da un gramo por la vía intramuscular y 0.5 gramo por pulverización en cada 24 horas.

3) El porvenir del carcinoma broncógeno debe mejorar con la disminución en la mortalidad subsiguiente a la neumonectomía. Los exámenes citológicos de secreciones o esputo obtenidas broncoscópicamente han ayudado enormemente y muchos casos con hallazgos broncoscópicos negativos se diagnostican ahora como carcinoma por la citología y se tratan con buen éxito. Los estudios indican que el porcentaje de operabilidad es más alto en los casos en los que la broncoscopía es negativa y la citología positiva.

4) Existe un interés creciente en la hernia del hiato ya que muchos de estos casos no están adaptados a la cirugía y requieren tratamiento mecánico. Se considera que en estos casos ataques repetidos de esofagitis es una posible causa de la cicatrización y acortamiento del esófago.

REFERENCES

1 Hilding, A. C. and Hilding, D.: "The Volume of the Bronchial Tree at Various Levels and Its Possible Physiologic Significance," *Ann. Otol., Rhinol. and Laryng.*, 57:324, (June) 1948.

2 Norris, C. M., Long, J., Oppenheimer, M. J. and Wester, M. R.: "Bronchospirography, Indications and Technic," *Ann. Otol., Rhinol. and Laryng.*, 57:828, (Sept.) 1948.

3 Heatley, C. A. and Emerson, E. B. Jr.: "Bronchoscopy in the Newborn: An Analysis of 50 Cases," *Ann. Otol., Rhinol. and Laryng.*, 57:802, (Sept.) 1948.

4 Holinger, P. H., Johnston, K. C. and Zoss, A. R.: "Tracheal and Bronchial Obstruction Due to Congenital Cardiovascular Anomalies," *Ann. Otol., Rhinol. and Laryng.*, 57:808, (Sept.) 1948.

5 Davison, F. W.: "Acute Laryngotracheobronchitis, Further Studies on Treatment," *Arch. Otolaryngol.*, 47:455, (April) 1948.

6 Prigal, S. J.: "Studies with Medicated Aerosols," *Ann. Int. Med.*, 28: 814, (April) 1948.

7 Hagens, E. W., Karp, M. and Farmer, C. J.: "Penicillin and Streptomycin Aerosol in the Treatment of Pulmonary Disease," *Arch. Otolaryng.*, 47:138, (Feb.) 1948.

8 Krasno, L., Karp, M. and Rhoads, P. S.: "The Inhalation of Dust Penicillin," *Ann. Int. Med.*, 28:607, (March) 1948.

9 Coates, E. O. Jr.: "Bronchoscopy in Pulmonary Tuberculosis. A Study of Post-bronchoscopic Increase in Disease," *Am. Rev. Tuberc.*, 58:412, (Oct.) 1948.

10 O'Keefe, J. J.: "The Use of Streptomycin in Tuberculosis Tracheobronchitis," *Ann. Otol., Rhinol. and Laryng.*, 57:784, (Sept.) 1948.

11 Hill, F. T.: "Granuloma of Larynx Following Endotracheal Anesthesia," *Ann. Otol., Rhinol. and Laryng.*, 57:910, (Sept.) 1948.

12 Holinger, P. H., Zoss, A. R. and Johnston, K. C.: "Rupture of Bronchus Due to External Chest Trauma: Report of Three Cases with Recovery," *Laryngoscope*, 58:817, (Aug.) 1948.

13 Hodes, P. J., Johnson, J. and Atkins, J. P.: "Traumatic Bronchial Rupture with Occlusion," *Am. J. Roentgenol.*, 60:448, (Oct.) 1948.

14 Norris, C. M.: "The Clinical Features of Bronchogenic Carcinoma," *Dis. of Chest*, 14:198, (Mar.-Apr.) 1948.

15 Clerf, L. H. and Herbut, P. A.: "The Value of Cytological Diagnosis of Pulmonary Malignancy," *Am. Rev. Tuberc.*, 61:60, (Jan.) 1950.

16 Olsen, A. M.: "Esophagitis," *Surg., Gynec. and Obst.*, 86:372, (Mar.) 1948.

17 Munoz-MacCormick, C. E.: "The Injection Treatment of Esophageal Varices Due to Manson's Schistosomiasis," *Laryngoscope*, 58:992, (Sept.) 1948.

Use of Human Thrombin in Some Cases of Pulmonary Hemorrhage

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Thrombin is the most "active clotter of blood or plasma known at the present time."[1] Since its isolation more than 10 years ago, bovine thrombin has been used in a great variety of surgical procedures, including ophthalmic surgery,[2] rhinological operations,[3] and in major surgical procedures including neurosurgery.[4] Its more recent application to the control of gastric hemorrhage by ingestion,[5] suggested that this substance might conceivably be used in the treatment of certain cases of pulmonary bleeding. It was administered by inhalation for this purpose by Puder,[6] whose report, however, had not yet appeared when these investigations were undertaken.

There are, however, a few objections, both theoretical and practical, to thrombin aerosol. In cases of massive hemorrhage, rapid clotting of the blood in the airways might induce asphyxia. Massive hemorrhage of the exsanguinating type such as occurs from the rupture of a large vein in a tuberculous cavity might, therefore, be a contraindication to the use of aerosol thrombin. *Bovine* thrombin is objectionable because it may prove sensitizing and provoke allergic reactions. *Bovine thrombin should not be used by aerosol in the human subject.* According to Bratton,[7] "Bovine thrombin, from antigenicity studies in guinea pigs, will be classified as a weak to moderately active antigen. Assuming that the antibody response in man is comparable to that in guinea pigs, there is little doubt in our mind that antibodies would be formed, perhaps even attached to pulmonary tissues, after administration of bovine thrombin by the aerosol technique. Since pulmonary bleeding is frequently a recurrent event, and treatment might possibly be repeated on several occasions, we feel there is grave danger of sensitization of the patient at the time of the initial use of the drug, and perhaps death would result from its second administration."

For aerosol purposes, therefore, the source of the thrombin *must be human* and not bovine. Fortunately, human thrombin is readily available. Indications for the use of human thrombin aerosol might extend not only to patients with pulmonary tuberculosis who are persistently or repeatedly bleeding but also to cases of hemorrhage from bronchiectasis or pulmonary neoplasms. In those

cases where bleeding obscures bronchoscopic inspection of a suspicious lesion, thrombin aerosol (or direct instillation through the bronchoscope) might be of particular value. The cases reported in this paper, however, are limited only to those of active pulmonary tuberculosis in all of whom active bleeding was present. As yet, it is too early to determine precisely the effect of the thrombin treatment on the underlying disease although no harm seems to have been done.

Preliminary Trials

Human thrombin in vials of 2500 units each was made available through the courtesy of Cutter Laboratories. Physiological saline is supplied as the diluent and the solution was freshly prepared in the strength of 500 to 1000 units per cc. at the time of administration. Experiments with these solutions were first begun on August 6, 1948 on two patients at the Boston State Hospital (M.D. and M.F.) with bilateral active tuberculosis who were streaking persistently. When it was demonstrated that the aerosol delivered through a hand nebulizer was easily tolerated, additional tests were conducted, using oxygen at a 6 to 10 liter flow per minute. One or two cc. of solution, containing from 500 to 2000 units, were aerosolized at each treatment. Such treatments were easily tolerated.

In order to observe any possible sensitizing action, these tests were repeated at weekly intervals for two weeks and then at biweekly intervals for two weeks. No further hemoptysis was noted after the first tests and no clinical evidence of sensitization was observed. During the same period of clinical observation three additional patients (W.C., T.G. and C.K.) were also given aerosol treatment with immediate effectiveness. In all of the cases studied, one course of treatment appeared to provide the patient with relief lasting for as long as two weeks or longer. It did not preclude the resumption of bleeding at a later date.

Case Report

Case Report: M. DeL., a 61 year old male, had his first hemoptysis 20 years ago and was treated by bed rest for six months in a sanatorium. He had another hemorrhage in 1935 for which he was again hospitalized and a left phrenic crush was done. He was discharged a year later as "arrested." During March 1948, he had severe hemorrhages but these quieted down with bed rest at home. Two months later bleeding recurred. At this time x-ray inspection of the chest revealed bilateral upper lobe disease, some elevation of the left diaphragm, and a suggestion of cavitation in the left lung.

He was treated conservatively at home with rest, sedation and the administration of menadione tablets. Sputum was negative on concen-

trate but positive by culture. One month later, however, he again expectorated a mouthful of blood and sputum concentrate at this time it was positive. He was again treated conservatively and the streaking gradually cleared. For the following year he had no active bleeding.

On July 11, 1949 he awoke with a sudden and massive hemoptysis. He resorted to codeine and menadione but this failed to control the bleeding. For the next five days bleeding persisted, both streaking and active hemorrhage that failed to respond to the usual conservative measures. He was hospitalized at a general hospital and pneumoperitoneum was immediately induced. Bleeding however persisted the remainder of that day and the next in spite of a large air refill. At about 2:00 a. m. on July 18 he had another massive hemoptysis in spite of a seemingly adequate pneumoperitoneum. The patient was given human thromin aerosol, 1,000 units in 2 cc. of saline with prompt inhibition of his bleeding and remarkable control of his cough.

For the next few days only slight streaking was evident. Pneumoperitoneum refills have been maintained. The patient was discharged home on July 26 since repeated sputum tests were negative for acid-fast organisms. He has had no bleeding or streaking. His cough is diminished and his dyspnea is less.

SUMMARY AND CONCLUSIONS

The use of *human* thrombin by aerosol administration appears to be effective in the control of certain cases of pulmonary hemorrhage and is worthy of more extended clinical trial.

RESUMEN Y CONCLUSIONES

El uso de la trombina *humana* administrada por aerosol parece ser efectiva en el dominio de ciertos casos de hemorragia pulmonar y vale la pena hacer ensayos clínicos más extensos con ella.

REFERENCES

1 Olwin, J. H. and Wahl, F. J.: "The Effect of Absorbable Sponge Materials on the Activity of Thrombin," *Surg., Gynec. and Obst.*, 86:203, 1948.
2 Perry, T. G. W. and Laszlo, G. C.: "Thrombin Technique in Ophthalmic Surgery," *Brit. J. Ophthalmol.*, 30:176, 1946.
3 Fox, S. L.: "Use of Thrombin in Nasal Surgery," *Ann. Otol., Rhinol. and Laryngol.*, 56:127, 1947.
4 Putman, T. J.: "Use of Thrombin on Soluble Celluslose in Neurosurgery," *Ann. Surg.*, 118:127, 1943.
5 Daly, B. M.: "Use of Buffer Thrombin in the Treatment of Gastric Hemorrhage," *Arch. Surg.*, 55:208, 1947.
6 Puder, S.: "Treatment of Pulmonary Hemorrhage by Inhalation of Thrombin," *Orvosi Hetilap*, Jan. 1949.
7 Bratton, A. C. Jr.: Personal communication.

Two Cases of Intra-Thoracic Kidney

WALTER F. BUGDEN, M.D.*
Syracuse, New York

The subject of diaphragmatic hernia has been extensively written about in the recent medical and surgical literature. The purpose of this communication is to present two cases of diaphragmatic hernia, in both of which the kidney (a retroperitoneal viscus) was the only organ herniated through the diaphragm. The first case was incorrectly diagnosed as a ganglio or neuro fibroma. The second was correctly diagnosed preoperatively.

Case 1: Claude Steele, a 16 year old male was admitted to St. Joseph's Hospital on March 27, 1947. He was well until October 1946 when he suffered an injury to his right lower chest and flank in an auto accident. He was not hospitalized. The following day he noted pain in his lower right chest. This pain recurred in several days and since persisted intermittently.

The physical examination was essentially negative and laboratory work was within normal limits. X-ray inspection of the chest revealed a mass in the right posterior mediastinum measuring five by six by four centimeters which was circumscribed and smooth in outline and descended with inspiration (Figs. 1 and 2).

Thoracotomy was done March 30, 1947 through the bed of the ninth rib. The mass could be seen presenting through the diaphragm. After

*From the Department of Surgery, Syracuse Medical College, Syracuse, New York.

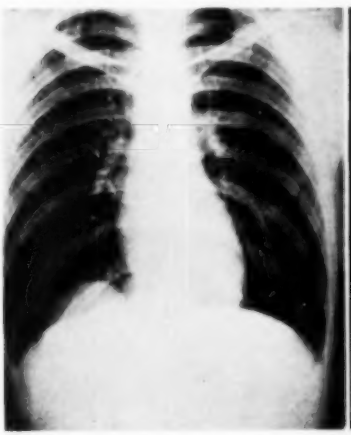

FIGURE 1

FIGURE 2

the diaphragmatic pleura was incised the mass was identified as the right kidney. This was dissected free and replaced in the retro-peritoneal space. The defect in the diaphragm was closed in two layers with silk. The phrenic nerve was crushed to paralyze the diaphragm. The pleural cavity was irrigated with warm saline and the wound closed in layers after the lung was inflated and 200,000 units of penicillin instilled into the pleural space.

The postoperative course was uneventful and re-check x-ray inspections have shown no recurrence on the hernia to date.

Case 2: William Hayes was admitted to Syracuse Memorial Hospital on January 16, 1949 with the history of a mass having been discovered during a routine chest x-ray inspection in May 1948. Barium studies were done to rule out hernia of the gastro intestinal tract. There were absolutely no symptoms. The physical examination was negative and the alboratory findings were within normal limits. X-ray inspection revealed a lemon sized mass in the posterior mediastinum. Fluoroscopy showed the mass to descend with respiration (Figs. 3 and 4). Intravenous pyelogram studies demonstrated clearly that the mass was an intrathoracic kidney (Fig. 5).

Under endotracheal general anesthesia, the chest was opened through the tenth rib bed. On opening the chest, a hernia of the left diaphragm could be seen near the lateral border at the costo-phrenic angle. On opening the diaphragmatic pleura, the left kidney was encountered, freed by blunt and sharp dissection, and replaced into the abdomen with some difficulty. The spleen and stomach were readily identified through the peritoneal reflexion, which was all that kept them from herniating up into the chest. The hernia was then repaired with interrupted mattress sutures, the layers were overlapped. The pleural space was drained with a rubber tube brain, through a stab wound in the eleventh interspace, posteriorly. The phrenic nerve was crushed as it traveled over the pericardium in order to immobilize the diaphragm. The chest was closed in layers, using interrupted silk.

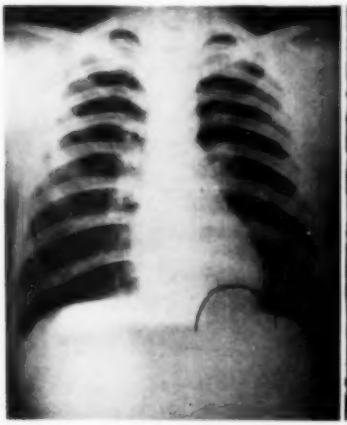

FIGURE 3

FIGURE 4

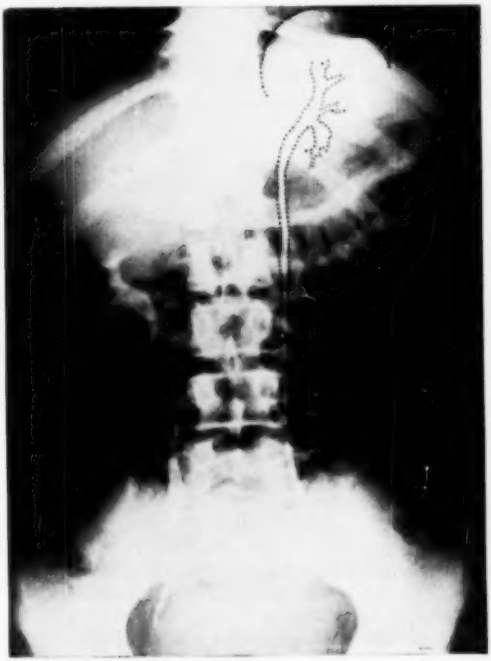

FIGURE 5

Comment

If the correct differential diagnosis is established with IV Pyelography, the patient may be spared a major surgical procedure. If the hernia is on the right side, it would seem that no other viscera would get into the thorax past the liver. If the hernia is on the left, it should be repaired, not primarily because of the intrathoracic kidney, but because of the possibility of intraperitoneal viscera being herniated into the chest at a future date. Conceivably a blow to the abdomen, as with a football tackle, would increase the intraabdominal pressure sufficiently to do this. In the left sided case of hernia reported, only the parietal peritoneum was holding back the spleen and stomach.

SUMMARY

Two cases of diaphragmatic hernia with thoracic kidney are reported. The necessity of surgical repair is discussed briefly.

RESUMEN

Se ha presentado dos casos de hernia diafragmático con riñón torácico. Se discuta brevemente la necesidad del reparo quirúrgico.

Sixteenth Annual Meeting of the College

SAINT FRANCIS HOTEL, SAN FRANCISCO, CALIFORNIA

JUNE 22 THROUGH JUNE 25, 1950

NINETY-NINTH ANNUAL SESSION

American Medical Association

San Francisco, June 26 through 30, 1950

The College will meet this year in San Francisco at the St. Francis Hotel on the dates June 22 through 25. The American Medical Association will meet in San Francisco on June 26 through 30.

If you are planning to attend the meetings, we urge you to make your reservations at once, using the official application form which appears in the Journal of the American Medical Association. Reservations for the annual meetings of the American College of Chest Physicians and the American Medical Association must be made through the A.M.A. Hotel Committee, Room 200, 61 Grove Street, San Francisco 2, California. Be sure to mention that you are going to attend the meeting of the American College of Chest Physicians so that you may be assigned to a hotel as close as possible to the College headquarters. It is essential that arrival and departure dates are given when reservations are requested.

The Committee on Scientific Program of the College, under the chairmanship of Dr. Herman J. Moersch of the Mayo Clinic, Rochester, Minnesota, has announced that the program for the 1950 annual meeting is almost complete. The following are some of the subjects to be presented in the scientific program:

"Streptomycin and Artificial Pneumoperitoneum in Pulmonary Tuberculosis."
"Comparative Morphology of Tubercle Bacillus."
"Clinical Results and Physiologic Effects of Immobilization of Lung."
"Para-aminosalicylic Acid."
"Present Status of Antibiotic Treatment in Pulmonary Tuberculosis."
"Clinical Evaluation of Cytologic Studies."
"Bronchoscopy in Study of Unexplained Hemoptysis."
"Treatment of Pulmonary Emphysema."
"Reversible Forms of Heart Disease."
"Tuberculosis Control in Institutions for the Mentally Ill."
"Bronchial Lavage."
"Fungus Diseases of the Lung."
"Oleothorax Following Pulmonary Resection."
"Cardiac Surgery."
"Complications Following Pulmonary Resection."
"Exploration of Coin Lesions."
"Present Status of Resection in Treatment of Pulmonary Tuberculosis."
"Bronchiogenic Carcinoma Masquerading as Other Diseases of the Chest."
"Consideration of the Clinical and Physiologic Factors in the Treatment of Chronic Pulmonary Conditions."

"Cardio-Respiratory Studies in Pre and Post Operative Funnel Chest (Pectus Excavatum)."
"Indications and Contra-Indications for Use of Decortication Procedures in Tuberculous Patients."

The Annual X-Ray Conference, a motion picture session on diseases of the chest, and round table luncheons will also be presented at the meeting. The complete program will be published in the April issue of "Diseases of the Chest."

College Chapter News

ARGENTINE CHAPTER

The following program was presented at the Fourth Annual Meeting of the Argentine Chapter of the College held in Rosario on December 3:

"The Value of Cultures and Innoculations of Sputum and Gastric Juices in the Diagnosis and Treatment of Pulmonary Tuberculosis," Jose M. Leston, M.D., Jose B. Gomez, M.D. and Abel Cetrangolo, M.D.

"The Value of the Investigation of Tubercle Bacillus Through Gastric Lavage in the Diagnosis of Pulmonary Tuberculosis," Isaac F. Wolaj, M.D., Juan B. Rocca, M.D. and Domingo Palazzo, M.D.

"The Centralization of Bacteriological Research," Gumersindo Sayago, M.D., F.C.C.P.

A business meeting of the chapter was held after the scientific program at which time the following officers were elected for 1950:

Oscar A. Vaccarezza, M.D., President.
Paulino A. Rojas, M.D., Vice-President.
Rodolfo Cuchiani Acevedo, M.D., Secretary-Treasurer.

MISSOURI CHAPTER

The Missouri Chapter will hold its next meeting on March 26 and 27 at the Hotel Statler, St. Louis, in conjunction with the Centennial Meeting of the Missouri State Medical Society. On March 26 the chapter will hold a luncheon and business meeting. Dr. F. K. Hansel will be the guest speaker and will present a paper on "The Importance of Bronchial-Cytology in the Diagnosis of Bronchopulmonary Diseases."

On the morning of March 27 the chapter has arranged a scientific program in which papers will be presented by Dr. Paul H. Holinger, Chicago, Illinois, on "Bronchial Obstruction Due to Endobronchial Lesions," and Dr. Alfred Goldman, St. Louis, Missouri, on "Streptomycin in the Treatment of Pulmonary Tuberculosis."

WISCONSIN CHAPTER

Dr. Karl E. Kassowitz addressed the Milwaukee Metropolitan Section of the College on the subject "Suppurative Diseases of the Chest in Childhood," on Friday, January 27, at the Medford Hotel, Milwaukee.

FLORIDA CHAPTER

The Florida Chapter will hold its Annual Meeting in Hollywood, Florida on Sunday, April 23. The program for the meeting is as follows:

9:30 a. m. — Business Meeting.

10:00 a. m. — Scientific Session:

"Psychic Factors in Diseases of the Chest,"
Arnold Anderson, M.D., F.C.C.P., St. Petersburg.

"Review of Pneumothorax and Pneumoperitoneum Cases in Southwestern States Sanatoria,"
John Barger, M.D., Tampa.

"Segmental Resections in Bronchiectasis,"
(Motion Pictures).
William Fowler, M.D., Orlando.

"Review of Antibiotics in the Treatment of Diseases of the Chest,"
Alexander Libow, M.D., F.C.C.P., Miami Beach.

"The Role of the Laryngologist and Bronchoscopist in Diseases of the Respiratory Tract,"
(Color Motion Pictures).
Nathaniel M. Levin, M.D., F.C.C.P., Miami.

1:00 p. m. — Lunch.

2:00 p. m. — Round Table Chest Conference,
M. Jay Flipse, M.D., F.C.C.P., Miami, Moderator.

Panel Discussion by Invitation:
X-Ray Aspects, David Kirsh, M.D., Miami.
Medical Aspects, David A. Nathan, M.D., F.C.C.P., Miami Beach.
Surgical Aspects, DeWitt C. Daughtry, M.D., Miami.
And Other Members of the Florida Chapter.

NEW JERSEY CHAPTER

The New Jersey Chapter met jointly with the Section of Medicine and Pediatrics of the Academy of Medicine of Northern New Jersey on Thursday, January 26, in Newark. Dr. Richard H. Overholt addressed the group on "The Necessity and Value of Thoracic Exploration," and Dr. Emanuel B. Schoenbach presented a paper on "The Use of Aureomycin in the Treatment of Pulmonary Infections."

The Annual Meeting of the Section on Diseases of the Chest of the New Jersey State Medical Society will meet in Atlantic City, New Jersey on Monday, May 22, 1950. The Program will be as follows:

"Extrapleural Pulmonary Resection. Evaluation of a New Procedure,"
Irving J. Selikoff, M.D., F.C.C.P., Paterson.
Discussion: Frank Bortone, M.D., F.C.C.P., Jersey City.

"Unusual Cases of Chest Pathology,"
Harrison Stanford Martland, M.D., Newark.
Discussion: Irving L. Applebaum, M.D., F.C.C.P., Newark.

Election of Officers.

Recess for Visiting Exhibits.

X-Ray Conference:
Cases of unusual interest will be diagnosed by a panel of four chest physicians and discussed by the audience. Merrill C. Sosman, M.D., Boston, Massachusetts, Moderator.

College News Notes

Dr. Donato G. Alarcon, Mexico City, Regent for Mexico, has been elected Vice-President of the Academy of Medicine of Mexico for 1950 and President-Elect for 1951. The Academy of Medicine of Mexico is the oldest and most famous medical association in Mexico. Only the top-ranking specialists in each medical branch are eligible for membership in the association.

On February 5 the National Conference on Medical Service was held at the Palmer House, Chicago, Illinois, under the presidency of Dr. John S. Bouslog of Denver, Colorado.

POSTGRADUATE COURSE IN BRONCHOESOPHAGOLOGY

Temple University School of Medicine, 3400 North Broad Street, Philadelphia 40, Pennsylvania. Postgraduate course in Bronchoscopy, Esophagoscopy and Laryngeal Surgery, 2 weeks, May 1-12, 1950. Fee, $250.

FELLOWSHIP CERTIFICATES AWARDED

The following new Fellows of the College received their Fellowship Certificates at the Convocation ceremony held at the Ambassador Hotel, Atlantic City, June 4, 1949, at the time of the Fifteenth Annual Meeting of the American College of Chest Physicians:

Hans Abeles, M.D., Kew Garden Hills, L. I., New York
David B. Aitchison, M.D., Hamilton, Ontario, Canada
Frederick K. Albrecht, M.D., Topeka, Kansas
Robert J. Anderson, M.D., Washington, D. C.
R. M. Anderson, M.D., Hackensack, New Jersey
Maxwell J. Antell, M.D., Bridgeport, Connetiuct
Jack D. Bartholomew, M.D., Boulder, Colorado
Otto S. Baum, M.D., South Orange, New Jersey
David Bernstein, M.D., Brooklyn, New York
Peter B. Bianco, M.D., Peoria, Illinois
Eugene W. Bogardus, M.D., Pleasantville, New York
Katherine R. Boucot, M.D., Philadelphia, Pennsylvania
Francis D. T. Bowen, M.D., Newington, Conneticut
Paul J. Breslich, M.D., Minot, North Dakota
Howard C. Burkhead, M.D., Long Branch, New Jersey
Louis Cherniack, M.D., Winnipeg, Manitoba, Canada
Arthur H. Chernoff, M.D., Saugus, Massachusetts
Pasquale Ciaglis, M.D., Utica, New York
Loren L. Collins, M.D., Edwardsville, Illinois
Reuben J. Cohen, M.D., Philadelphia, Pennsylvania
George W. Cragg, M.D., Cornwell, Ontario, Canada
Joseph S. Cruise, M.D., Atlanta, Georgia
George Curtis Crump, M.D., Asheville, North Carolina
Joseph D. Cuono, M.D., Verona, New Jersey
Gisela K. Davidson, M.D., Portland, Maine
Richard de Butts, M.D., Washington, D. C.

Hugo O. Deuss, M.D., Chicago, Illinois
Lloyd B. Dickey, M.D., San Francisco, California
Edward Dunner, M.D., Livermore, California
Ralph E. Dwork, M.D., Brooklyn, New York
Kenneth I. Fetterhoff, M.D., Pittsburgh, Pennsylvania
Hyman Fisher, M.D., Sunmount, New York
James W. Fouche, M.D., Columbia, South Carolina
David I. Frank, M.D., New York, New York
Benjamin Freedman, M.D., Wynantskill, New York
Frederick O. R. Garner, M.D., Victoria, B. C., Canada
Joseph N. Gehlen, M.D., Saint Paul, Minnesota
Clyde W. George, M.D., Buffalo, New York
Joseph H. Geyer, M.D., Columbus, Ohio
Charles W. Gillen, Haileybury, Ontario, Canada
Sidney I. Goldberg, M.D., New York, New York
Edwin J. Grace, M.D., Brooklyn, New York
Morris Greenberg, M.D., Jacksonville, Illinois
John H. Gross, M.D., Fort San., Sask., Canada
Max Gross, M.D., Margate City, New Jersey
Matthew R. Hadley, M.D., McKeesport, Pennsylvania
J. Ivan Hershey, M.D., Bryn Mawr, Pennsylvania
Ilse Hirschfeld, M.D., Glen Gardner, New Jersey
Charles Hyman, M.D., Atlantic City, New Jersey
Benjamin Israel, M.D., Bronx, New York
Thornton S. Jennings, M.D., Martinsburg, West Virginia
Robert E. Joseph, M.D., Salem, Oregon
Karl E. Kassowitz, M.D., Milwaukee, Wisconsin
Earle B. Kay, M.D., Cleveland, Ohio
Martin Kettler, M.D., Glenn Dale, Maryland
Francis G. Kravec, M.D., Youngstown, Ohio
Frank Lamberta, M.D., Jamaica, L. I., New York
Vera Leites, M.D., New York, New York
James W. Macdonald, M.D., Pittsburgh, Pennsylvania
Simon Marcus, M.D., Sherbrooke, Quebec, Canada
John M. McDougall, M.D., Brantford, Ontario, Canada
John B. McHugh, M.D., Outwood, Kentucky
Richard H. Meade, Jr., M.D., Grand Rapids, Michigan
Jonathan Meakins, M.D., Montreal, Quebec, Canada
David Meyers, M.D., New York, New York
Daniel A. Mulvihill, M.D., New York, New York
Emil A. Naclerio, M.D., New York, New York
Francis E. O'Brien, M.D., Haydenville, Massachusetts
Lee Ogden, M.D., New York, New York
John Frederic Paterson, M.D., Toronto, Ontario, Canada
Clarence H. Payne, M.D., Chicago, Illinois
John L. Pool, M.D., New York, New York
Edward E. Rockey, M.D., New York, New York
Leonard Schneider, M.D., Bradley Beach, New Jersey
Charles Schuman, M.D., New York, New York
George Robert Schwartz, M.D., St. Petersburg, Florida
Irving J. Selikoff, M.D., Paterson, New Jersey
Clarence M. Sharp, M.D., Jacksonville, Florida
Sidney P. Shear, M.D., Hollywood, California
Leslie Munro Spratt, M.D., London, Ontario, Canada

Theodore J. Talbot, M.D., Staten Island, New York
Arthur D. Ward, M.D., Worcester, Massachusetts
Arthur Watt, M.D., London, Ontario, Canada
William Weingarten, M.D., Staten Island, New York
L. Spires Whitaker, M.D., Chattanooga, Tennessee
Michael Yankowicz, M.D., Prescott, Arizona
Isadore Zapolsky, M.D., Elgin, Illinois

Obituaries

Samuel Budd English

1877 - 1949

Dr. Samuel B. English died at the Union Forge Nursing Home in Glen Gardner, New Jersey on November 3, 1949 of cerebral hemorrhage at the age of 72. He was a pioneer in the campaign against tuberculosis. He was the former Superintendent of the New Jersey State Sanatorium at Glen Gardner, New Jersey. At that institution he was the first superintendent assuming that position in 1907 even before the construction was completed, and maintained that office until two years ago when he was retired. He was born in 1877 at Leeds Point, Atlantic County, New Jersey where his father conducted a general store and also taught school. He graduated from the Jefferson Medical College in 1906 and interned at the Cooper Hospital, Camden, New Jersey.

New Jersey was the thirteenth state to erect a hospital for the treatment of tuberculosis and Dr. English was selected as the first superintendent of that institution, established in Glen Gardner, New Jersey. When he assumed charge there was no organized fight against tuberculosis in the State. He opened one of the first free public clinics for the diagnosis and treatment of tuberculosis at St. Michael's Hospital, Newark, New Jersey. The clinic was later transferred to the Center Market and then to the Newark Health Department. Under his supervision clinics and admission stations were created in all large cities of New Jersey. In 1920 the legislature approved $10,000 for the extention of these clinics into the rural areas. No section of the state was uncovered by physicians working under the supervision of Dr. English.

Dr. English was active in obtaining legislation for private county tuberculosis hospitals and began this work in 1912. He later was active in introducing tuberculin testing among high school students and in 1934 offered the facilities at Glen Gardner Sanatorium for tuberculin testing of students of the Warren County High School. As the result of his activity a law was passed in 1939 requiring that all Boards of Education provide for tuberculin testing or x-raying of high school pupils and all school personnel. He was one of the founders of the New Jersey Chapter of the American College of Chest Physicians, a charter member of the New Jersey Trudeau Society, a past president of the New Jersey Health and Sanitary Association and past president of the New Jersey Tuberculosis League. He was also a member of the Hunterdon County Medical Society, the Medical Society of the State of New Jersey, American Medical Association, the National Tuberculosis League and the American Public Health Association.

New Jersey mourns the loss of one of its outstanding physicians, a man who pioneered the diagnosis and treatment of tuberculosis, and was active in stimulating physicians to study diseases of the lungs. He had magnetic qualities, a pleasing personality, was admired and respected by all who knew him. His memory will be forever cherished by his friends and associates throughout this State. He has been an international figure in the fight against tuberculosis and we of the New Jersey Chapter feel that we have lost one of our most outstanding members.

Irving Willner, M.D., Governor for New Jersey.

Marshall Rowles Beard

1911-1949

Dr. Marshall R. Beard died at his home in San Fernando, California on July 24, 1949. He was born October 6, 1911 in Sacramento, California. He received his degree of Doctor of Medicine from McGill University in 1938.

Dr. Beard took his internship at the Sacramento County Hospital during the year 1938-1939. Following this, he was a resident at the Butte County Hospital. He next served on the staff of Weimar Sanatorium. He joined the staff of Olive View Sanatorium on January 5, 1948 and continued in this position until his death.

He was an Associate Fellow of the American College of Chest Physicians, a member of the Los Angeles County Association, and a member of the staff of the San Fernando Hospital.

He leaves his wife, Jean, and two children.

Buford H. Wardrip, M.D., Governor for California.

John Eugene Fahy

1876-1949

Dr. John E. Fahy of Prescott, Arizona, died on November 4, 1949. He was former clinical director of the Veterans Administration Center at Whipple, Arizona. Dr. Fahy was born in Philadelphia, Pennsylvania and received his early education there. He received his degree of Doctor of Medicine from the University of Pennsylvania in 1901 and interned in St. Joseph's and Methodist Hospitals in 1901 and 1902. Until 1906 he practiced in Philadelphia and then moved to California where he developed his specialties in the treatment of chest disease and cardiac conditions, working in the Los Angeles County Hospital and in Los Angeles city and county clinics.

In 1917 he was commissioned a major in the army and was assigned to tuberculosis and cardiac examining boards. Later he was stationed at Fitzsimons General Hospital at Denver, serving there until discharge in 1920. He then entered the U. S. Public Health Service and was sent to Whipple barracks in April 1920.

He subsequently served at the Veterans Hospitals in Walla Walla, Washington, Dwight, Illinois, Kansas City, Missouri, Fort Bayard, New Mexico, Livermore, California, returning to Whipple in 1941 where he served until his retirement in September 1946.

Dr. Fahy was a Fellow Emeritus of the American College of Chest Physicians and also held membership in the Yavapai County Medical Society and the American Trudeau Society. He is survived by his wife, Mae Ruth Sheehan Fahy.

Roy A. Wolford, M.D., Governor for the Veterans Administration.

Book Review

BOVINE TUBERCULOSIS. Including a contrast with Human Tuberculosis: By John Francis, B.Sc., M.R.C.V.S., Imperial Chemical Industries Limited, Biological Laboratories, Wilmslow, Cheshire. Staples Press Limited, Cavendish Place, London, W1, New York, Toronto.

Public health aspects of bovine tuberculosis were not well understood prior to the twentieth century. In fact, the seriousness of this problem has been truly appreciated only during the past two or three decades. In this book of 220 pages, Francis has done a fine service by assembling a large volume of information on bovine tuberculosis from various parts of the world. His history of the disease among cattle is excellent. He points out that it has been recognized in the Mediterranean littoral at least since classical times, that it slowly spread during the Middle Ages and it probably was not until the early nineteenth century that cattle of all parts of Europe were infected. He presents evidence to show that in Britain, bovine tubercle bacilli may have been introduced by Roman cattle, but more likely by Dutch cattle during the seventeenth and eighteenth centuries. The subsequent introduction of European, chiefly British, cattle resulted in global distribution of the disease during the nineteenth century.

While the bovine type of tubercle bacillus has caused most of the destruction in cattle, the human and avian types sensitize their tissues so they react to tuberculin. He points out that the bovine type of tubercle bacillus can cause serious disease in nearly every species of mammals, including man, and that in Great Britain approximately 5 per cent of deaths from tuberculosis at all ages are due to the bovine type of bacillus, while among children under the age of five years, 30 per cent of the deaths from tuberculosis are due to this organism. It is estimated that 1,000 to 2,000 deaths are caused annually by the bovine type of tubercle bacillus in Great Britain. About 8 per cent of raw churned milk and nearly all of the 3,000 gallon tanks in which milk is often brought to the large cities contain tubercle bacilli. Since there is no possibility of completely changing this situation promptly, he strongly urges efficient pasteurization of all milk.

The various methods of detecting tuberculosis in cattle are presented, and he points out that the single intradermal tuberculin test is by far the most effective method of determining the presence of tuberculosis in animals.

In the discussion of vaccination against tuberculosis, he mentions several of the numerous attempts that have been made since 1899 to produce an efficacious immunizing substance. He gives a brief history of BCG which was introduced with the hope of immunizing cattle and first reported in 1911. Several of the many reports made since that time are presented. He states that striking immunity can be demonstrated

when vaccinated calves are exposed to a single infecting dose two to three months after vaccination, but that results have been disappointing when vaccinated animals have been exposed to infection in controlled trials under semi-natural conditions for a number of years. Revaccination does not appear to maintain immunity at a high level, and little difference in extent of the disease has been demonstrated in vaccinated and control animals. He also calls attention to the more recent attempts to immunize animals with the vole acid-fast bacillus, but results to date have not been significantly different than those from the use of BCG.

This book contains an excellent section on the control of bovine tuberculosis. Methods that have been used in various countries are discussed. The author states that the best method to date consists of herd and area eradication by which all the animals of a herd or an area are tested with tuberculin and the reactors slaughtered. Once this has been done, the tuberculosis-free animals must be protected against the introduction of tuberculous animals.

Francis calls attention to man as a source of tuberculous infection for cattle. While persons eliminating the human type of tubercle bacillus may cause animals to become reactors so they must be slaughtered, there is much greater danger from people eliminating the bovine type of tubercle bacillus which not only causes the tuberculin reaction, but destructive disease among cattle.

The attested herd scheme was introduced in Great Britain in 1935. Nearly 800,000 cattle, which is about 10 per cent of all of Great Britain's cattle, are now in attested herds. He believes this is by far the best method of control and says, "There is very little evidence that vaccination could play an important part in the eradication of tuberculosis." The incidence of tuberculosis in all cattle in Great Britain is probably about 18 per cent.

Throughout the book, the author frequently calls attention to the tuberculosis eradication programs in other countries and especially that of the United States, where in 1949 the incidence of tuberculosis among cattle was only 0.19 per cent. This was accomplished on the area plan, using the county as the unit. Francis believes that if Great Britain can continue to create attested herds at the same rate as in 1938-39, she will have practically eradicated bovine tuberculosis within 30 to 40 years.

Bovine tuberculosis is an exceedingly important disease and since it is to highly transmissible to man who may pass it back to cattle and transmit it to other animals and people, it is obvious that tuberculosis can never be eradicated from humans as long as it is tolerated among animals and vice versa. In the United States tuberculosis among cattle has been eradicated from large areas and is near eradication in the remainder of the country. Even the small amount that remains constitutes a threat to the cattle herds, other domestic animals and to people themselves. Therefore, the veterinarians and their co-workers should receive every necessary support to attain complete eradication of tuberculosis from the cattle herds.

Tuberculosis among cattle is a global problem and must be attacked on that basis. Therefore, this book by Francis should be read everywhere, not only by veterinarians, but also by physicians in human medicine, public health workers and all others who desire to eradicate this disease from the world.

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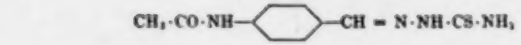

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REF.: Hinshaw, H. C. and McDermott, W.: Report to the Clinical Subcommittee of the Committee on Medical Research and Therapy, Amer. Review of Tuberculosis, 1950, 61, 157

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